2-AMINO-4-CARBOXAMIDE-BENZAZEPINE IMMUNOCONJUGATES, AND USES THEREOF

CROSS REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims the benefit of priority to U.S. Provisional Application No. 63/166,716, filed 26 March 2021, which is incorporated by reference in its entirety.

SEQUENCE LISTING

The instant application contains a Sequence Listing which has been submitted electronically in ASCII format and is hereby incorporated by reference in its entirety. Said ASCII copy, created on March 25, 2022, is named 17019_016WO1_SL.txt and is 85,369 bytes in size.

FIELD OF THE INVENTION

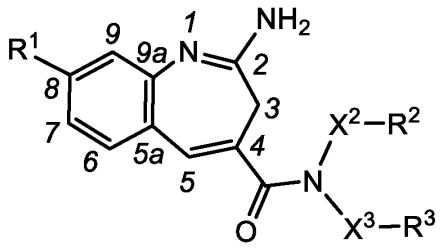
The invention relates generally to an immunoconjugate comprising an antibody conjugated to one or more 2-amino-4-carboxamide-benzazepine molecules.

BACKGROUND OF THE INVENTION

New compositions and methods for the delivery of antibodies and dendritic cell/myeloid cell adjuvants are needed in order to reach inaccessible tumors and/or to expand treatment options for cancer patients and other subjects. The invention provides such compositions and methods.

SUMMARY OF THE INVENTION

The invention is generally directed to immunoconjugates comprising an antibody linked by conjugation to one or more 2-amino-4-carboxamide-benzazepine derivatives. The invention is further directed to 2-amino-4-carboxamide-benzazepine derivative intermediate compositions comprising a reactive functional group. Such intermediate compositions are suitable substrates for formation of immunoconjugates wherein an antibody may be covalently bound by a linker L to the 4-position of an 2-amino-4-carboxamide-benzazepine moiety having the formula:



where R^3 is attached to the linker L. The positions of the 3H-benzo[b]azepine structure are numbered according to IUPAC conventions. The X^{2-3} and R^{1-3} substituents are defined herein. Additionally, the carbon atoms at the 7- and 8-positions may independently be replaced by nitrogen to form the pyridyl and pyrazine analogs of 3H-benzo[b]azepines.

The invention is further directed to use of such an immunoconjugates in the treatment of an illness, in particular cancer.

An aspect of the invention is an immunoconjugate comprising an antibody covalently attached to a linker which is covalently attached to one or more 2-amino-4-carboxamide-benzazepine moieties.

Another aspect of the invention is a 2-amino-4-carboxamide-benzazepine-linker compound.

Another aspect of the invention is a method for treating cancer comprising administering a therapeutically effective amount of an immunoconjugate comprising an antibody linked by conjugation to one or more 2-amino-4-carboxamide-benzazepine moieties.

Another aspect of the invention is a use of an immunoconjugate comprising an antibody linked by conjugation to one or more 2-amino-4-carboxamide-benzazepine moieties for treating cancer.

Another aspect of the invention is a method of preparing an immunoconjugate by conjugation of one or more 2-amino-4-carboxamide-benzazepine moieties with an antibody.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to certain embodiments of the invention, examples of which are illustrated in the accompanying structures and formulas. While the invention will be described in conjunction with the enumerated embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover all alternatives, modifications, and equivalents, which may be included within the scope of the invention as defined by the claims.

One skilled in the art will recognize many methods and materials similar or equivalent to those described herein, which could be used in the practice of the present invention. The invention is in no way limited to the methods and materials described.

DEFINITIONS

The terms "Toll-like receptor" and "TLR" refer to any member of a family of highly-conserved mammalian proteins which recognizes pathogen-associated molecular patterns and acts as key signaling elements in innate immunity. TLR polypeptides share a characteristic structure that includes an extracellular domain that has leucine-rich repeats, a transmembrane domain, and an intracellular domain that is involved in TLR signaling.

The terms "Toll-like receptor 7" and "TLR7" refer to nucleic acids or polypeptides sharing at least about 70%, about 80%, about 90%, about 95%, about 96%, about 97%, about 98%, about 99%, or more sequence identity to a publicly-available TLR7 sequence, e.g., GenBank accession number AAZ99026 for human TLR7 polypeptide, or GenBank accession number AAK62676 for murine TLR7 polypeptide.

The terms "Toll-like receptor 8" and "TLR8" refer to nucleic acids or polypeptides sharing at least about 70%, about 80%, about 90%, about 95%, about 96%, about 97%, about 98%, about 99%, or more sequence identity to a publicly-available TLR7 sequence, e.g., GenBank accession number AAZ95441 for human TLR8 polypeptide, or GenBank accession number AAK62677 for murine TLR8 polypeptide.

A "TLR agonist" is a substance that binds, directly or indirectly, to a TLR (e.g., TLR7 and/or TLR8) to induce TLR signaling. Any detectable difference in TLR signaling can indicate that an agonist stimulates or activates a TLR. Signaling differences can be manifested, for example, as changes in the expression of target genes, in the phosphorylation of signal transduction components, in the intracellular localization of downstream elements such as nuclear factor-κB (NF-κB), in the association of certain components (such as IL-1 receptor associated kinase (IRAK)) with other proteins or intracellular structures, or in the biochemical activity of components such as kinases (such as mitogen-activated protein kinase (MAPK)).

"Antibody" refers to a polypeptide comprising an antigen binding region (including the complementarity determining region (CDRs)) from an immunoglobulin gene or fragments thereof. The term "antibody" specifically encompasses monoclonal antibodies (including full length monoclonal antibodies), polyclonal antibodies, multispecific antibodies (e.g., bispecific antibodies), and antibody fragments that exhibit the desired biological activity. An exemplary immunoglobulin (antibody) structural unit comprises a tetramer. Each tetramer is composed of two identical pairs of polypeptide chains, each pair having one "light" (about 25 kDa) and one "heavy" chain (about 50-70 kDa) connected by disulfide bonds. Each chain is composed of structural domains, which are referred to as immunoglobulin domains. These domains are classified into different categories by size and function, e.g., variable domains or regions on the light and heavy chains (V_L and V_H, respectively) and constant domains or regions on the light

and heavy chains (C_L and C_H, respectively). The N-terminus of each chain defines a variable region of about 100 to 110 or more amino acids, referred to as the paratope, primarily responsible for antigen recognition, i.e., the antigen binding domain. Light chains are classified as either kappa or lambda. Heavy chains are classified as gamma, mu, alpha, delta, or epsilon, which in turn define the immunoglobulin classes, IgG, IgM, IgA, IgD and IgE, respectively. IgG antibodies are large molecules of about 150 kDa composed of four peptide chains. IgG antibodies contain two identical class γ heavy chains of about 50 kDa and two identical light chains of about 25 kDa, thus a tetrameric quaternary structure. The two heavy chains are linked to each other and to a light chain each by disulfide bonds. The resulting tetramer has two identical halves, which together form the Y-like shape. Each end of the fork contains an identical antigen binding domain. There are four IgG subclasses (IgG1, IgG2, IgG3, and IgG4) in humans, named in order of their abundance in serum (i.e., IgG1 is the most abundant). Typically, the antigen binding domain of an antibody will be most critical in specificity and affinity of binding to cancer cells.

"Bispecific" antibodies (bsAbs) are antibodies that bind two distinct epitopes to cancer (Suurs F.V. et al (2019) *Pharmacology & Therapeutics* 201: 103-119). Bispecific antibodies may engage immune cells to destroy tumor cells, deliver payloads to tumors, and/or block tumor signaling pathways. An antibody that targets a particular antigen includes a bispecific or multispecific antibody with at least one antigen binding region that targets the particular antigen. In some embodiments, the targeted monoclonal antibody is a bispecific antibody with at least one antigen binding region that targets tumor cells. Such antigens include but are not limited to: mesothelin, prostate specific membrane antigen (PSMA), HER2, TROP2, CEA, EGFR, 5T4, Nectin4, CD19, CD20, CD22, CD30, CD70, B7H3, B7H4 (also known as 08E), protein tyrosine kinase 7 (PTK7), glypican-3, RG1, fucosyl-GMl, CTLA-4, and CD44 (WO 2017/196598).

An antibody that targets a particular antigen includes a bispecific or multispecific antibody with at least one antigen binding region that targets the particular antigen. In some embodiments, the targeted monoclonal antibody is a bispecific antibody with at least one antigen binding region that targets tumor cells. Such antigens include CD47, SIRPalpha, Dectin-2, PD-1, and PD-L1.

"Antibody construct" refers to an antibody or a fusion protein comprising (i) an antigen binding domain and (ii) an Fc domain.

The term "immunoconjugate" refers to an antibody construct that is covalently bonded to an adjuvant moiety via a linker. Immunoconjugates allow targeted delivery of an active adjuvant moiety while the target antigen is bound.

"Adjuvant" refers to a substance capable of eliciting an immune response in a subject exposed to the adjuvant. The phrase "adjuvant moiety" refers to an adjuvant that is covalently bonded to an antibody construct, e.g., through a linker, as described herein. The adjuvant moiety can elicit the immune response while bonded to the antibody construct or after cleavage (e.g., enzymatic cleavage) from the antibody construct following administration of an immunoconjugate to the subject.

In some embodiments, the binding agent is an antigen-binding antibody "fragment," which is a construct that comprises at least an antigen-binding region of an antibody, alone or with other components that together constitute the antigen-binding construct. Many different types of antibody "fragments" are known in the art, including, for instance, (i) a Fab fragment, which is a monovalent fragment consisting of the V_L, V_H, C_L, and CH_1 domains, (ii) a $F(ab')_2$ fragment, which is a bivalent fragment comprising two Fab fragments linked by a disulfide bridge at the hinge region, (iii) a Fv fragment consisting of the V_L and V_H domains of a single arm of an antibody, (iv) a Fab' fragment, which results from breaking the disulfide bridge of an $F(ab')_2$ fragment using mild reducing conditions, (v) a disulfide-stabilized Fv fragment (dsFv), and (vi) a single chain Fv (scFv), which is a monovalent molecule consisting of the two domains of the Fv fragment (i.e., V_L and V_H) joined by a synthetic linker which enables the two domains to be synthesized as a single polypeptide chain.

The antibody or antibody fragments can be part of a larger construct, for example, a conjugate or fusion construct of the antibody fragment to additional regions. For instance, in some embodiments, the antibody fragment can be fused to an Fc region as described herein. In other embodiments, the antibody fragment (e.g., a Fab or scFv) can be part of a chimeric antigen receptor or chimeric T-cell receptor, for instance, by fusing to a transmembrane domain (optionally with an intervening linker or "stalk" (e.g., hinge region)) and optional intercellular signaling domain. For instance, the antibody fragment can be fused to the gamma and/or delta chains of a t-cell receptor, so as to provide a T-cell receptor like construct that binds PD-L1. In yet another embodiment, the antibody fragment is part of a bispecific T-cell engager (BiTEs) comprising a CD1 or CD3 binding domain and linker.

"Cysteine-mutant antibody" is an antibody in which one or more amino acid residues of an antibody are substituted with cysteine residues. A cysteine-mutant antibody may be prepared from the parent antibody by antibody engineering methods (Junutula, et al., (2008b) *Nature Biotech.*, 26(8):925-932; Dornan et al. (2009) *Blood* 114(13):2721-2729; US 7521541; US 7723485; US 2012/0121615; WO 2009/052249). Cysteine residues provide for site-specific conjugation of a adjuvant such as a TLR agonist to the antibody through the reactive cysteine thiol groups at the engineered cysteine sites but do not perturb immunoglobulin folding and

assembly or alter antigen binding and effector functions. Cysteine-mutant antibodies can be conjugated to the TLR agonist-linker compound with uniform stoichiometry of the immunoconjugate (e.g., up to two TLR agonist moieties per antibody in an antibody that has a single engineered, mutant cysteine site). The TLR agonist-linker compound has a reactive electrophilic group to react specifically with the free cysteine thiol groups of the cysteine-mutant antibody.

"Epitope" means any antigenic determinant or epitopic determinant of an antigen to which an antigen binding domain binds (i.e., at the paratope of the antigen binding domain). Antigenic determinants usually consist of chemically active surface groupings of molecules, such as amino acids or sugar side chains, and usually have specific three dimensional structural characteristics, as well as specific charge characteristics.

The terms "Fc receptor" or "FcR" refer to a receptor that binds to the Fc region of an antibody. There are three main classes of Fc receptors: (1) FcγR which bind to IgG, (2) FcαR which binds to IgA, and (3) FcεR which binds to IgE. The FcγR family includes several members, such as FcγI (CD64), FcγRIIA (CD32A), FcγRIIB (CD32B), FcγRIIIA (CD16A), and FcγRIIIB (CD16B). The Fcγ receptors differ in their affinity for IgG and also have different affinities for the IgG subclasses (e.g., IgG1, IgG2, IgG3, and IgG4).

As used herein, the phrase "immune checkpoint inhibitor" refers to any modulator that inhibits the activity of the immune checkpoint molecule. Immune checkpoint inhibitors can include, but are not limited to, immune checkpoint molecule binding proteins, small molecule inhibitors, antibodies (including bispecific and multispecific antibodies with at least one antigen binding region that targets an immune checkpoint protein, e.g., bispecific or multispecific antibodies that do not exclusively target immune checkpoint proteins, as well as antibodies that are dual immunomodulators (simultaneous targeting two immunomodulating targets), which result in blockade of inhibitory targets, depletion of suppressive cells, and/or activation of effector cells; tumor-targeted immunomodulators (directs potent costimulation to the tumor-infiltrating immune cells by targeting a tumor antigen and costimulatory molecules such as CD40 or 4-1BB); NK-cell redirectors (redirects NK cells to malignant cells by targeting a tumor antigen and CD16A); or T-cell redirectors (redirects T cells to malignant cells by targeting a tumor antigen and CD3)), antibody-derivatives (including Fc fusions, Fab fragments, and scFvs), antibody-drug conjugates, antisense oligonucleotides, siRNA, aptamers, peptides and peptide mimetics.

Nucleic acid or amino acid sequence "identity," as referenced herein, can be determined by comparing a nucleic acid or amino acid sequence of interest to a reference nucleic acid or amino acid sequence. The percent identity is the number of nucleotides or amino acid residues

that are the same (i.e., that are identical) as between the optimally aligned sequence of interest and the reference sequence divided by the length of the longest sequence (i.e., the length of either the sequence of interest or the reference sequence, whichever is longer). Alignment of sequences and calculation of percent identity can be performed using available software programs. Examples of such programs include CLUSTAL-W, T-Coffee, and ALIGN (for alignment of nucleic acid and amino acid sequences), BLAST programs (e.g., BLAST 2.1, BL2SEQ, BLASTp, BLASTn, and the like) and FASTA programs (e.g., FASTA3x, FASTM, and SSEARCH) (for sequence alignment and sequence similarity searches). Sequence alignment algorithms also are disclosed in, for example, Altschul et al., *J. Molecular Biol.*, 215(3): 403-410 (1990), Beigert et al., *Proc. Natl. Acad. Sci. USA*, *106*(10): 3770-3775 (2009), Durbin et al., eds., *Biological Sequence Analysis: Probalistic Models of Proteins and Nucleic Acids*, Cambridge University Press, Cambridge, UK (2009), Soding, *Bioinformatics*, 21(7): 951-960 (2005), Altschul et al., *Nucleic Acids Res.*, 25(17): 3389-3402 (1997), and Gusfield, *Algorithms on Strings, Trees and Sequences*, Cambridge University Press, Cambridge UK (1997)). Percent (%) identity of sequences can be also calculated, for example, as 100 x [(identical positions)/min(TG_A, TG_B)], where TG_A and TG_B are the sum of the number of residues and internal gap positions in peptide sequences A and B in the alignment that minimizes TG_A and TG_B. See, e.g., Russell et al., *J. Mol Biol.*, 244: 332-350 (1994).

The binding agent comprises Ig heavy and light chain variable region polypeptides that together form the antigen binding site. Each of the heavy and light chain variable regions are polypeptides comprising three complementarity determining regions (CDR1, CDR2, and CDR3) connected by framework regions. The binding agent can be any of a variety of types of binding agents known in the art that comprise Ig heavy and light chains. For instance, the binding agent can be an antibody, an antigen-binding antibody "fragment," or a T-cell receptor.

"Biosimilar" refers to an approved antibody construct that has active properties similar to, for example, a PD-L1-targeting antibody construct previously approved such as atezolizumab (TECENTRIQ™, Genentech, Inc.), durvalumab (IMFINZI™, AstraZeneca), and avelumab (BAVENCIO™, EMD Serono, Pfizer); a HER2-targeting antibody construct previously approved such as trastuzumab (HERCEPTIN™, Genentech, Inc.), and pertuzumab (PERJETA™, Genentech, Inc.); or a CEA-targeting antibody such as labetuzumab (CEA-CIDE™, MN-14, hMN14, Immunomedics) CAS Reg. No. 219649-07-7).

"Biobetter" refers to an approved antibody construct that is an improvement of a previously approved antibody construct, such as atezolizumab, durvalumab, avelumab, trastuzumab, pertuzumab, and labetuzumab. The biobetter can have one or more modifications

(e.g., an altered glycan profile, or a unique epitope) over the previously approved antibody construct.

"Amino acid" refers to any monomeric unit that can be incorporated into a peptide, polypeptide, or protein. Amino acids include naturally-occurring α-amino acids and their stereoisomers, as well as unnatural (non-naturally occurring) amino acids and their stereoisomers. "Stereoisomers" of a given amino acid refer to isomers having the same molecular formula and intramolecular bonds but different three-dimensional arrangements of bonds and atoms (e.g., an L-amino acid and the corresponding D-amino acid). The amino acids can be glycosylated (e.g., *N*-linked glycans, *O*-linked glycans, phosphoglycans, *C*-linked glycans, or glypication) or deglycosylated. Amino acids may be referred to herein by either the commonly known three letter symbols or by the one-letter symbols recommended by the IUPAC-IUB Biochemical Nomenclature Commission.

Naturally-occurring amino acids are those encoded by the genetic code, as well as those amino acids that are later modified, e.g., hydroxyproline, γ-carboxyglutamate, and *O*-phosphoserine. Naturally-occurring α-amino acids include, without limitation, alanine (Ala), cysteine (Cys), aspartic acid (Asp), glutamic acid (Glu), phenylalanine (Phe), glycine (Gly), histidine (His), isoleucine (Ile), arginine (Arg), lysine (Lys), leucine (Leu), methionine (Met), asparagine (Asn), proline (Pro), glutamine (Gln), serine (Ser), threonine (Thr), valine (Val), tryptophan (Trp), tyrosine (Tyr), and combinations thereof. Stereoisomers of naturally-occurring α-amino acids include, without limitation, D-alanine (D-Ala), D-cysteine (D-Cys), D-aspartic acid (D-Asp), D-glutamic acid (D-Glu), D-phenylalanine (D-Phe), D-histidine (D-His), D-isoleucine (D-Ile), D-arginine (D-Arg), D-lysine (D-Lys), D-leucine (D-Leu), D-methionine (D-Met), D-asparagine (D-Asn), D-proline (D-Pro), D-glutamine (D-Gln), D-serine (D-Ser), D-threonine (D-Thr), D-valine (D-Val), D-tryptophan (D-Trp), D-tyrosine (D-Tyr), and combinations thereof.

Naturally-occurring amino acids include those formed in proteins by post-translational modification, such as citrulline (Cit).

Unnatural (non-naturally occurring) amino acids include, without limitation, amino acid analogs, amino acid mimetics, synthetic amino acids, *N*-substituted glycines, and *N*-methyl amino acids in either the L- or D-configuration that function in a manner similar to the naturally-occurring amino acids. For example, "amino acid analogs" can be unnatural amino acids that have the same basic chemical structure as naturally-occurring amino acids (i.e., a carbon that is bonded to a hydrogen, a carboxyl group, an amino group) but have modified side-chain groups or modified peptide backbones, e.g., homoserine, norleucine, methionine sulfoxide, and methionine methyl sulfonium. "Amino acid mimetics" refer to chemical compounds that have a

structure that is different from the general chemical structure of an amino acid, but that functions in a manner similar to a naturally-occurring amino acid.

"Linker" refers to a functional group that covalently bonds two or more moieties in a compound or material. For example, the linking moiety can serve to covalently bond an adjuvant moiety to an antibody construct in an immunoconjugate.

"Linking moiety" refers to a functional group that covalently bonds two or more moieties in a compound or material. For example, the linking moiety can serve to covalently bond an adjuvant moiety to an antibody in an immunoconjugate. Useful bonds for connecting linking moieties to proteins and other materials include, but are not limited to, amides, amines, esters, carbamates, ureas, thioethers, thiocarbamates, thiocarbonates, and thioureas.

"Divalent" refers to a chemical moiety that contains two points of attachment for linking two functional groups; polyvalent linking moieties can have additional points of attachment for linking further functional groups. Divalent radicals may be denoted with the suffix "diyl". For example, divalent linking moieties include divalent polymer moieties such as divalent poly(ethylene glycol), divalent cycloalkyl, divalent heterocycloalkyl, divalent aryl, and divalent heteroaryl group. A "divalent cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group" refers to a cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group having two points of attachment for covalently linking two moieties in a molecule or material. Cycloalkyl, heterocycloalkyl, aryl, or heteroaryl groups can be substituted or unsubstituted. Cycloalkyl, heterocycloalkyl, aryl, or heteroaryl groups can be substituted with one or more groups selected from halo, hydroxy, amino, alkylamino, amido, acyl, nitro, cyano, and alkoxy.

A wavy line (" ~~~ ") represents a point of attachment of the specified chemical moiety. If the specified chemical moiety has two wavy lines (" ~~~ ") present, it will be understood that the chemical moiety can be used bilaterally, i.e., as read from left to right or from right to left. In some embodiments, a specified moiety having two wavy lines (" ~~~ ") present is considered to be used as read from left to right.

"Alkyl" refers to a straight (linear) or branched, saturated, aliphatic radical having the number of carbon atoms indicated. Alkyl can include any number of carbons, for example from one to twelve. Examples of alkyl groups include, but are not limited to, methyl (Me, $-CH_3$), ethyl (Et, $-CH_2CH_3$), 1-propyl (n-Pr, n-propyl, $-CH_2CH_2CH_3$), 2-propyl (i-Pr, i-propyl, $-CH(CH_3)_2$), 1-butyl (n-Bu, n-butyl, $-CH_2CH_2CH_2CH_3$), 2-methyl-1-propyl (i-Bu, i-butyl, $-CH_2CH(CH_3)_2$), 2-butyl (s-Bu, s-butyl, $-CH(CH_3)CH_2CH_3$), 2-methyl-2-propyl (t-Bu, t-butyl, $-C(CH_3)_3$), 1-pentyl (n-pentyl, $-CH_2CH_2CH_2CH_2CH_3$), 2-pentyl ($-CH(CH_3)CH_2CH_2CH_3$), 3-pentyl ($-CH(CH_2CH_3)_2$), 2-methyl-2-butyl ($-C(CH_3)_2CH_2CH_3$), 3-methyl-2-butyl ($-CH(CH_3)CH(CH_3)_2$), 3-methyl-1-butyl ($-CH_2CH_2CH(CH_3)_2$), 2-methyl-1-butyl ($-CH_2CH(CH_3)CH_2CH_3$), 1-hexyl (-

$CH_2CH_2CH_2CH_2CH_2CH_3$), 2-hexyl (-$CH(CH_3)CH_2CH_2CH_2CH_3$), 3-hexyl (-$CH(CH_2CH_3)(CH_2CH_2CH_3)$), 2-methyl-2-pentyl (-$C(CH_3)_2CH_2CH_2CH_3$), 3-methyl-2-pentyl (-$CH(CH_3)CH(CH_3)CH_2CH_3$), 4-methyl-2-pentyl (-$CH(CH_3)CH_2CH(CH_3)_2$), 3-methyl-3-pentyl (-$C(CH_3)(CH_2CH_3)_2$), 2-methyl-3-pentyl (-$CH(CH_2CH_3)CH(CH_3)_2$), 2,3-dimethyl-2-butyl (-$C(CH_3)_2CH(CH_3)_2$), 3,3-dimethyl-2-butyl (-$CH(CH_3)C(CH_3)_3$, 1-heptyl, 1-octyl, and the like. Alkyl groups can be substituted or unsubstituted. "Substituted alkyl" groups can be substituted with one or more groups selected from halo, hydroxy, amino, oxo (=O), alkylamino, amido, acyl, nitro, cyano, and alkoxy.

The term "alkyldiyl" refers to a divalent alkyl radical. Examples of alkyldiyl groups include, but are not limited to, methylene (-CH_2-), ethylene (-CH_2CH_2-), propylene (-$CH_2CH_2CH_2$-), and the like. An alkyldiyl group may also be referred to as an "alkylene" group.

"Alkenyl" refers to a straight (linear) or branched, unsaturated, aliphatic radical having the number of carbon atoms indicated and at least one carbon-carbon double bond, *sp*2. Alkenyl can include from two to about 12 or more carbons atoms. Alkenyl groups are radicals having "cis" and "trans" orientations, or alternatively, "E" and "Z" orientations. Examples include, but are not limited to, ethylenyl or vinyl (-$CH=CH_2$), allyl (-$CH_2CH=CH_2$). butenyl, pentenyl, and isomers thereof. Alkenyl groups can be substituted or unsubstituted. "Substituted alkenyl" groups can be substituted with one or more groups selected from halo, hydroxy, amino, oxo (=O), alkylamino, amido, acyl, nitro, cyano, and alkoxy.

The terms "alkenylene" or "alkenyldiyl" refer to a linear or branched-chain divalent hydrocarbon radical. Examples include, but are not limited to, ethylenylene or vinylene (-CH=CH-), allyl (-CH_2CH=CH-), and the like.

"Alkynyl" refers to a straight (linear) or branched, unsaturated, aliphatic radical having the number of carbon atoms indicated and at least one carbon-carbon triple bond, *sp*. Alkynyl can include from two to about 12 or more carbons atoms. For example, C_2-C_6 alkynyl includes, but is not limited to ethynyl (-C≡CH), propynyl (propargyl, -CH_2C≡CH), butynyl, pentynyl, hexynyl, and isomers thereof Alkynyl groups can be substituted or unsubstituted. "Substituted alkynyl" groups can be substituted with one or more groups selected from halo, hydroxy, amino, oxo (=O), alkylamino, amido, acyl, nitro, cyano, and alkoxy.

The term "alkynylene" or "alkynyldiyl" refer to a divalent alkynyl radical.

The terms "carbocycle", "carbocyclyl", "carbocyclic ring" and "cycloalkyl" refer to a saturated or partially unsaturated, monocyclic, fused bicyclic, or bridged polycyclic ring assembly containing from 3 to 12 ring atoms, or the number of atoms indicated. Saturated monocyclic carbocyclic rings include, for example, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, and cyclooctyl. Saturated bicyclic and polycyclic carbocyclic rings include, for

example, norbornane, [2.2.2] bicyclooctane, decahydronaphthalene and adamantane. Carbocyclic groups can also be partially unsaturated, having one or more double or triple bonds in the ring. Representative carbocyclic groups that are partially unsaturated include, but are not limited to, cyclobutene, cyclopentene, cyclohexene, cyclohexadiene (1,3- and 1,4-isomers), cycloheptene, cycloheptadiene, cyclooctene, cyclooctadiene (1,3-, 1,4- and 1,5-isomers), norbornene, and norbornadiene.

The term "cycloalkyldiyl" refers to a divalent cycloalkyl radical.

"Aryl" refers to a monovalent aromatic hydrocarbon radical of 6-20 carbon atoms (C_6–C_{20}) derived by the removal of one hydrogen atom from a single carbon atom of a parent aromatic ring system.. Aryl groups can be monocyclic, fused to form bicyclic or tricyclic groups, or linked by a bond to form a biaryl group. Representative aryl groups include phenyl, naphthyl and biphenyl. Other aryl groups include benzyl, having a methylene linking group. Some aryl groups have from 6 to 12 ring members, such as phenyl, naphthyl or biphenyl. Other aryl groups have from 6 to 10 ring members, such as phenyl or naphthyl.

The terms "arylene" or "aryldiyl" mean a divalent aromatic hydrocarbon radical of 6-20 carbon atoms (C_6–C_{20}) derived by the removal of two hydrogen atom from a two carbon atoms of a parent aromatic ring system. Some aryldiyl groups are represented in the exemplary structures as "Ar". Aryldiyl includes bicyclic radicals comprising an aromatic ring fused to a saturated, partially unsaturated ring, or aromatic carbocyclic ring. Typical aryldiyl groups include, but are not limited to, radicals derived from benzene (phenyldiyl), substituted benzenes, naphthalene, anthracene, biphenylene, indenylene, indanylene, 1,2-dihydronaphthalene, 1,2,3,4-tetrahydronaphthyl, and the like. Aryldiyl groups are also referred to as "arylene", and are optionally substituted with one or more substituents described herein.

The terms "heterocycle," "heterocyclyl" and "heterocyclic ring" are used interchangeably herein and refer to a saturated or a partially unsaturated (i.e., having one or more double and/or triple bonds within the ring) carbocyclic radical of 3 to about 20 ring atoms in which at least one ring atom is a heteroatom selected from nitrogen, oxygen, phosphorus and sulfur, the remaining ring atoms being C, where one or more ring atoms is optionally substituted independently with one or more substituents described below. A heterocycle may be a monocycle having 3 to 7 ring members (2 to 6 carbon atoms and 1 to 4 heteroatoms selected from N, O, P, and S) or a bicycle having 7 to 10 ring members (4 to 9 carbon atoms and 1 to 6 heteroatoms selected from N, O, P, and S), for example: a bicyclo [4,5], [5,5], [5,6], or [6,6] system. Heterocycles are described in Paquette, Leo A.; "Principles of Modern Heterocyclic Chemistry" (W.A. Benjamin, New York, 1968), particularly Chapters 1, 3, 4, 6, 7, and 9; "The Chemistry of Heterocyclic Compounds, A series of Monographs" (John Wiley & Sons, New

York, 1950 to present), in particular Volumes 13, 14, 16, 19, and 28; and J. Am. Chem. Soc. (1960) 82:5566. "Heterocyclyl" also includes radicals where heterocycle radicals are fused with a saturated, partially unsaturated ring, or aromatic carbocyclic or heterocyclic ring. Examples of heterocyclic rings include, but are not limited to, morpholin-4-yl, piperidin-1-yl, piperazinyl, piperazin-4-yl-2-one, piperazin-4-yl-3-one, pyrrolidin-1-yl, thiomorpholin-4-yl, S-dioxothiomorpholin-4-yl, azocan-1-yl, azetidin-1-yl, octahydropyrido[1,2-a]pyrazin-2-yl, [1,4]diazepan-1-yl, pyrrolidinyl, tetrahydrofuranyl, dihydrofuranyl, tetrahydrothienyl, tetrahydropyranyl, dihydropyranyl, tetrahydrothiopyranyl, piperidino, morpholino, thiomorpholino, thioxanyl, piperazinyl, homopiperazinyl, azetidinyl, oxetanyl, thietanyl, homopiperidinyl, oxepanyl, thiepanyl, oxazepinyl, diazepinyl, thiazepinyl, 2-pyrrolinyl, 3-pyrrolinyl, indolinyl, 2H-pyranyl, 4H-pyranyl, dioxanyl, 1,3-dioxolanyl, pyrazolinyl, dithianyl, dithiolanyl, dihydropyranyl, dihydrothienyl, dihydrofuranyl, pyrazolidinylimidazolinyl, imidazolidinyl, 3-azabicyco[3.1.0]hexanyl, 3-azabicyclo[4.1.0]heptanyl, azabicyclo[2.2.2]hexanyl, 3H-indolyl quinolizinyl and N-pyridyl ureas. Spiro heterocyclyl moieties are also included within the scope of this definition. Examples of spiro heterocyclyl moieties include azaspiro[2.5]octanyl and azaspiro[2.4]heptanyl. Examples of a heterocyclic group wherein 2 ring atoms are substituted with oxo (=O) moieties are pyrimidinonyl and 1,1-dioxo-thiomorpholinyl. The heterocycle groups herein are optionally substituted independently with one or more substituents described herein.

The term "heterocyclyldiyl" refers to a divalent, saturated or a partially unsaturated (i.e., having one or more double and/or triple bonds within the ring) carbocyclic radical of 3 to about 20 ring atoms in which at least one ring atom is a heteroatom selected from nitrogen, oxygen, phosphorus and sulfur, the remaining ring atoms being C, where one or more ring atoms is optionally substituted independently with one or more substituents as described. Examples of 5-membered and 6-membered heterocyclyldiyls include morpholinyldiyl, piperidinyldiyl, piperazinyldiyl, pyrrolidinyldiyl, dioxanyldiyl, thiomorpholinyldiyl, and S-dioxothiomorpholinyldiyl.

The term "heteroaryl" refers to a monovalent aromatic radical of 5-, 6-, or 7-membered rings, and includes fused ring systems (at least one of which is aromatic) of 5-20 atoms, containing one or more heteroatoms independently selected from nitrogen, oxygen, and sulfur. Examples of heteroaryl groups are pyridinyl (including, for example, 2-hydroxypyridinyl), imidazolyl, imidazopyridinyl, pyrimidinyl (including, for example, 4-hydroxypyrimidinyl), pyrazolyl, triazolyl, pyrazinyl, tetrazolyl, furyl, thienyl, isoxazolyl, thiazolyl, oxadiazolyl, oxazolyl, isothiazolyl, pyrrolyl, quinolinyl, isoquinolinyl, tetrahydroisoquinolinyl, indolyl, benzimidazolyl, benzofuranyl, cinnolinyl, indazolyl, indolizinyl, phthalazinyl, pyridazinyl,

triazinyl, isoindolyl, pteridinyl, purinyl, oxadiazolyl, thiadiazolyl, thiadiazolyl, furazanyl, benzofurazanyl, benzothiophenyl, benzothiazolyl, benzoxazolyl, quinazolinyl, quinoxalinyl, naphthyridinyl, and furopyridinyl. Heteroaryl groups are optionally substituted independently with one or more substituents described herein.

The term "heteroaryldiyl" refers to a divalent aromatic radical of 5-, 6-, or 7-membered rings, and includes fused ring systems (at least one of which is aromatic) of 5-20 atoms, containing one or more heteroatoms independently selected from nitrogen, oxygen, and sulfur. Examples of 5-membered and 6-membered heteroaryldiyls include pyridyldiyl, imidazolyldiyl, pyrimidinyldiyl, pyrazolyldiyl, triazolyldiyl, pyrazinyldiyl, tetrazolyldiyl, furyldiyl, thienyldiyl, isoxazolyldiyldiyl, thiazolyldiyl, oxadiazolyldiyl, oxazolyldiyl, isothiazolyldiyl, and pyrrolyldiyl.

The heterocycle or heteroaryl groups may be carbon (carbon-linked), or nitrogen (nitrogen-linked) bonded where such is possible. By way of example and not limitation, carbon bonded heterocycles or heteroaryls are bonded at position 2, 3, 4, 5, or 6 of a pyridine, position 3, 4, 5, or 6 of a pyridazine, position 2, 4, 5, or 6 of a pyrimidine, position 2, 3, 5, or 6 of a pyrazine, position 2, 3, 4, or 5 of a furan, tetrahydrofuran, thiofuran, thiophene, pyrrole or tetrahydropyrrole, position 2, 4, or 5 of an oxazole, imidazole or thiazole, position 3, 4, or 5 of an isoxazole, pyrazole, or isothiazole, position 2 or 3 of an aziridine, position 2, 3, or 4 of an azetidine, position 2, 3, 4, 5, 6, 7, or 8 of a quinoline or position 1, 3, 4, 5, 6, 7, or 8 of an isoquinoline.

By way of example and not limitation, nitrogen bonded heterocycles or heteroaryls are bonded at position 1 of an aziridine, azetidine, pyrrole, pyrrolidine, 2-pyrroline, 3-pyrroline, imidazole, imidazolidine, 2-imidazoline, 3-imidazoline, pyrazole, pyrazoline, 2-pyrazoline, 3-pyrazoline, piperidine, piperazine, indole, indoline, 1H-indazole, position 2 of a isoindole, or isoindoline, position 4 of a morpholine, and position 9 of a carbazole, or β-carboline.

The terms "halo" and "halogen," by themselves or as part of another substituent, refer to a fluorine, chlorine, bromine, or iodine atom.

The term "carbonyl," by itself or as part of another substituent, refers to C(=O) or –C(=O)–, i.e., a carbon atom double-bonded to oxygen and bound to two other groups in the moiety having the carbonyl.

As used herein, the phrase "quaternary ammonium salt" refers to a tertiary amine that has been quaternized with an alkyl substituent (e.g., a C_1-C_4 alkyl such as methyl, ethyl, propyl, or butyl).

The terms "treat," "treatment," and "treating" refer to any indicia of success in the treatment or amelioration of an injury, pathology, condition (e.g., cancer), or symptom (e.g.,

cognitive impairment), including any objective or subjective parameter such as abatement; remission; diminishing of symptoms or making the symptom, injury, pathology, or condition more tolerable to the patient; reduction in the rate of symptom progression; decreasing the frequency or duration of the symptom or condition; or, in some situations, preventing the onset of the symptom. The treatment or amelioration of symptoms can be based on any objective or subjective parameter, including, for example, the result of a physical examination.

The terms "cancer," "neoplasm," and "tumor" are used herein to refer to cells which exhibit autonomous, unregulated growth, such that the cells exhibit an aberrant growth phenotype characterized by a significant loss of control over cell proliferation. Cells of interest for detection, analysis, and/or treatment in the context of the invention include cancer cells (e.g., cancer cells from an individual with cancer), malignant cancer cells, pre-metastatic cancer cells, metastatic cancer cells, and non-metastatic cancer cells. Cancers of virtually every tissue are known. The phrase "cancer burden" refers to the quantum of cancer cells or cancer volume in a subject. Reducing cancer burden accordingly refers to reducing the number of cancer cells or the cancer cell volume in a subject. The term "cancer cell" as used herein refers to any cell that is a cancer cell (e.g., from any of the cancers for which an individual can be treated, e.g., isolated from an individual having cancer) or is derived from a cancer cell, e.g., clone of a cancer cell. For example, a cancer cell can be from an established cancer cell line, can be a primary cell isolated from an individual with cancer, can be a progeny cell from a primary cell isolated from an individual with cancer, and the like. In some embodiments, the term can also refer to a portion of a cancer cell, such as a sub-cellular portion, a cell membrane portion, or a cell lysate of a cancer cell. Many types of cancers are known to those of skill in the art, including solid tumors such as carcinomas, sarcomas, glioblastomas, melanomas, lymphomas, and myelomas, and circulating cancers such as leukemias.

As used herein, the term "cancer" includes any form of cancer, including but not limited to, solid tumor cancers (e.g., skin, lung, prostate, breast, gastric, bladder, colon, ovarian, pancreas, kidney, liver, glioblastoma, medulloblastoma, leiomyosarcoma, head & neck squamous cell carcinomas, melanomas, and neuroendocrine) and liquid cancers (e.g., hematological cancers); carcinomas; soft tissue tumors; sarcomas; teratomas; melanomas; leukemias; lymphomas; and brain cancers, including minimal residual disease, and including both primary and metastatic tumors.

"PD-L1 expression" refers to a cell that has a PD-L1 receptor on the cell's surface. As used herein "PD-L1 overexpression" refers to a cell that has more PD-L1 receptors as compared to corresponding non-cancer cell.

"HER2" refers to the protein human epidermal growth factor receptor 2.

"HER2 expression" refers to a cell that has a HER2 receptor on the cell's surface. For example, a cell may have from about 20,000 to about 50,000 HER2 receptors on the cell's surface. As used herein "HER2 overexpression" refers to a cell that has more than about 50,000 HER2 receptors. For example, a cell 2, 5, 10, 100, 1,000, 10,000, 100,000, or 1,000,000 times the number of HER2 receptors as compared to corresponding non-cancer cell (e.g., about 1 or 2 million HER2 receptors). It is estimated that HER2 is overexpressed in about 25% to about 30% of breast cancers.

"TROP2 expression" refers to a cell that has a TROP2 receptor on the cell's surface. As used herein "TROP2 expression" refers to a cell that has more TROP2 receptors as compared to a corresponding normal, non-cancer cell. It is estimated that TROP2 is overexpressed in about 74% breast cancers, 72% colorectal cancers, and 64% lung cancers, and other organ types of cancer.

The "pathology" of cancer includes all phenomena that compromise the well-being of the patient. This includes, without limitation, abnormal or uncontrollable cell growth, metastasis, interference with the normal functioning of neighboring cells, release of cytokines or other secretory products at abnormal levels, suppression or aggravation of inflammatory or immunological response, neoplasia, premalignancy, malignancy, and invasion of surrounding or distant tissues or organs, such as lymph nodes.

As used herein, the phrases "cancer recurrence" and "tumor recurrence," and grammatical variants thereof, refer to further growth of neoplastic or cancerous cells after diagnosis of cancer. Particularly, recurrence may occur when further cancerous cell growth occurs in the cancerous tissue. "Tumor spread," similarly, occurs when the cells of a tumor disseminate into local or distant tissues and organs, therefore, tumor spread encompasses tumor metastasis. "Tumor invasion" occurs when the tumor growth spread out locally to compromise the function of involved tissues by compression, destruction, or prevention of normal organ function.

As used herein, the term "metastasis" refers to the growth of a cancerous tumor in an organ or body part, which is not directly connected to the organ of the original cancerous tumor. Metastasis will be understood to include micrometastasis, which is the presence of an undetectable amount of cancerous cells in an organ or body part that is not directly connected to the organ of the original cancerous tumor. Metastasis can also be defined as several steps of a process, such as the departure of cancer cells from an original tumor site, and migration and/or invasion of cancer cells to other parts of the body.

The phrases "effective amount" and "therapeutically effective amount" refer to a dose or amount of a substance such as an immunoconjugate that produces therapeutic effects for which

it is administered. The exact dose will depend on the purpose of the treatment, and will be ascertainable by one skilled in the art using known techniques (see, e.g., Lieberman, *Pharmaceutical Dosage Forms* (vols. 1-3, 1992); Lloyd, *The Art, Science and Technology of Pharmaceutical Compounding* (1999); Pickar, *Dosage Calculations* (1999); *Goodman & Gilman's The Pharmacological Basis of Therapeutics*, 11th Edition (McGraw-Hill, 2006); and *Remington: The Science and Practice of Pharmacy*, 22nd Edition, (Pharmaceutical Press, London, 2012)). In the case of cancer, the therapeutically effective amount of the immunoconjugate may reduce the number of cancer cells; reduce the tumor size; inhibit (i.e., slow to some extent and preferably stop) cancer cell infiltration into peripheral organs; inhibit (i.e., slow to some extent and preferably stop) tumor metastasis; inhibit, to some extent, tumor growth; and/or relieve to some extent one or more of the symptoms associated with the cancer. To the extent the immunoconjugate may prevent growth and/or kill existing cancer cells, it may be cytostatic and/or cytotoxic. For cancer therapy, efficacy can, for example, be measured by assessing the time to disease progression (TTP) and/or determining the response rate (RR)

"Recipient," "individual," "subject," "host," and "patient" are used interchangeably and refer to any mammalian subject for whom diagnosis, treatment, or therapy is desired (e.g., humans). "Mammal" for purposes of treatment refers to any animal classified as a mammal, including humans, domestic and farm animals, and zoo, sports, or pet animals, such as dogs, horses, cats, cows, sheep, goats, pigs, camels, etc. In certain embodiments, the mammal is human.

The phrase "synergistic adjuvant" or "synergistic combination" in the context of this invention includes the combination of two immune modulators such as a receptor agonist, cytokine, and adjuvant polypeptide, that in combination elicit a synergistic effect on immunity relative to either administered alone. Particularly, the immunoconjugates disclosed herein comprise synergistic combinations of the claimed adjuvant and antibody construct. These synergistic combinations upon administration elicit a greater effect on immunity, e.g., relative to when the antibody construct or adjuvant is administered in the absence of the other moiety. Further, a decreased amount of the immunoconjugate may be administered (as measured by the total number of antibody constructs or the total number of adjuvants administered as part of the immunoconjugate) compared to when either the antibody construct or adjuvant is administered alone.

As used herein, the term "administering" refers to parenteral, intravenous, intraperitoneal, intramuscular, intratumoral, intralesional, intranasal, or subcutaneous administration, oral administration, administration as a suppository, topical contact, intrathecal

administration, or the implantation of a slow-release device, e.g., a mini-osmotic pump, to the subject.

The terms "about" and "around," as used herein to modify a numerical value, indicate a close range surrounding the numerical value. Thus, if "X" is the value, "about X" or "around X" indicates a value of from 0.9X to 1.1X, e.g., from 0.95X to 1.05X or from 0.99X to 1.01X. A reference to "about X" or "around X" specifically indicates at least the values X, 0.95X, 0.96X, 0.97X, 0.98X, 0.99X, 1.01X, 1.02X, 1.03X, 1.04X, and 1.05X. Accordingly, "about X" and "around X" are intended to teach and provide written description support for a claim limitation of, e.g., "0.98X."

ANTIBODIES

The immunoconjugate of the invention comprises an antibody. Included in the scope of the embodiments of the invention are functional variants of the antibody constructs or antigen binding domain described herein. The term "functional variant" as used herein refers to an antibody construct having an antigen binding domain with substantial or significant sequence identity or similarity to a parent antibody construct or antigen binding domain, which functional variant retains the biological activity of the antibody construct or antigen binding domain of which it is a variant. Functional variants encompass, for example, those variants of the antibody constructs or antigen binding domain described herein (the parent antibody construct or antigen binding domain) that retain the ability to recognize target cells expressing PD-L1, HER2, CEA, or TROP2 to a similar extent, the same extent, or to a higher extent, as the parent antibody construct or antigen binding domain.

In reference to the antibody construct or antigen binding domain, the functional variant can, for instance, be at least about 30%, about 50%, about 75%, about 80%, about 85%, about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, about 99% or more identical in amino acid sequence to the antibody construct or antigen binding domain.

A functional variant can, for example, comprise the amino acid sequence of the parent antibody construct or antigen binding domain with at least one conservative amino acid substitution. Alternatively, or additionally, the functional variants can comprise the amino acid sequence of the parent antibody construct or antigen binding domain with at least one non-conservative amino acid substitution. In this case, it is preferable for the non-conservative amino acid substitution to not interfere with or inhibit the biological activity of the functional variant. The non-conservative amino acid substitution may enhance the biological activity of

the functional variant, such that the biological activity of the functional variant is increased as compared to the parent antibody construct or antigen binding domain.

Amino acid substitutions of the inventive antibody constructs or antigen binding domains are preferably conservative amino acid substitutions. Conservative amino acid substitutions are known in the art, and include amino acid substitutions in which one amino acid having certain physical and/or chemical properties is exchanged for another amino acid that has the same or similar chemical or physical properties. For instance, the conservative amino acid substitution can be an acidic/negatively charged polar amino acid substituted for another acidic/negatively charged polar amino acid (e.g., Asp or Glu), an amino acid with a nonpolar side chain substituted for another amino acid with a nonpolar side chain (e.g., Ala, Gly, Val, Ile, Leu, Met, Phe, Pro, Trp, Cys, Val, etc.), a basic/positively charged polar amino acid substituted for another basic/positively charged polar amino acid (e.g., Lys, His, Arg, etc.), an uncharged amino acid with a polar side chain substituted for another uncharged amino acid with a polar side chain (e.g., Asn, Gln, Ser, Thr, Tyr, etc.), an amino acid with a beta-branched side-chain substituted for another amino acid with a beta-branched side-chain (e.g., Ile, Thr, and Val), an amino acid with an aromatic side-chain substituted for another amino acid with an aromatic side chain (e.g., His, Phe, Trp, and Tyr), etc.

The antibody construct or antigen binding domain can consist essentially of the specified amino acid sequence or sequences described herein, such that other components, e.g., other amino acids, do not materially change the biological activity of the antibody construct or antigen binding domain functional variant.

In some embodiments, the antibodies in the immunoconjugates contain a modified Fc region, wherein the modification modulates the binding of the Fc region to one or more Fc receptors.

In some embodiments, the antibodies in the immunoconjugates (e.g., antibodies conjugated to at least two adjuvant moieties) contain one or more modifications (e.g., amino acid insertion, deletion, and/or substitution) in the Fc region that results in modulated binding (e.g., increased binding or decreased binding) to one or more Fc receptors (e.g., FcγRI (CD64), FcγRIIA (CD32A), FcγRIIB (CD32B), FcγRIIIA (CD16a), and/or FcγRIIIB (CD16b)) as compared to the native antibody lacking the mutation in the Fc region. In some embodiments, the antibodies in the immunoconjugates contain one or more modifications (e.g., amino acid insertion, deletion, and/or substitution) in the Fc region that reduce the binding of the Fc region of the antibody to FcγRIIB. In some embodiments, the antibodies in the immunoconjugates contain one or more modifications (e.g., amino acid insertion, deletion, and/or substitution) in the Fc region of the antibody that reduce the binding of the antibody to FcγRIIB while

maintaining the same binding or having increased binding to FcγRI (CD64), FcγRIIA (CD32A), and/or FcRγIIIA (CD16a) as compared to the native antibody lacking the mutation in the Fc region. In some embodiments, the antibodies in the immunoconjugates contain one of more modifications in the Fc region that increase the binding of the Fc region of the antibody to FcγRIIB.

In some embodiments, the modulated binding is provided by mutations in the Fc region of the antibody relative to the native Fc region of the antibody. The mutations can be in a CH2 domain, a CH3 domain, or a combination thereof. A "native Fc region" is synonymous with a "wild-type Fc region" and comprises an amino acid sequence that is identical to the amino acid sequence of an Fc region found in nature or identical to the amino acid sequence of the Fc region found in the native antibody (e.g., cetuximab). Native sequence human Fc regions include a native sequence human IgG1 Fc region, native sequence human IgG2 Fc region, native sequence human IgG3 Fc region, and native sequence human IgG4 Fc region, as well as naturally occurring variants thereof. Native sequence Fc includes the various allotypes of Fcs (Jefferis et al., (2009) mAbs, 1(4):332-338).

In some embodiments, the mutations in the Fc region that result in modulated binding to one or more Fc receptors can include one or more of the following mutations: SD (S239D), SDIE (S239D/I332E), SE (S267E), SELF (S267E/L328F), SDIE (S239D/I332E), SDIEAL (S239D/I332E/A330L), GA (G236A), ALIE (A330L/I332E), GASDALIE (G236A/S239D/A330L/I332E), V9 (G237D/P238D/P271G/A330R), and V11 (G237D/P238D/H268D/P271G/A330R), and/or one or more mutations at the following amino acids: E233, G237, P238, H268, P271, L328 and A330. Additional Fc region modifications for modulating Fc receptor binding are described in, for example, US 2016/0145350 and US 7416726 and US 5624821, which are hereby incorporated by reference in their entireties.

In some embodiments, the Fc region of the antibodies of the immunoconjugates are modified to have an altered glycosylation pattern of the Fc region compared to the native non-modified Fc region.

Human immunoglobulin is glycosylated at the Asn297 residue in the Cγ2 domain of each heavy chain. This N-linked oligosaccharide is composed of a core heptasaccharide, N-acetylglucosamine4Mannose3 (GlcNAc4Man3). Removal of the heptasaccharide with endoglycosidase or PNGase F is known to lead to conformational changes in the antibody Fc region, which can significantly reduce antibody-binding affinity to activating FcγR and lead to decreased effector function. The core heptasaccharide is often decorated with galactose, bisecting GlcNAc, fucose, or sialic acid, which differentially impacts Fc binding to activating and inhibitory FcγR. Additionally, it has been demonstrated that α2,6-sialyation enhances

anti-inflammatory activity in vivo, while defucosylation leads to improved FcγRIIIa binding and a 10-fold increase in antibody-dependent cellular cytotoxicity and antibody-dependent phagocytosis. Specific glycosylation patterns, therefore, can be used to control inflammatory effector functions.

In some embodiments, the modification to alter the glycosylation pattern is a mutation. For example, a substitution at Asn297. In some embodiments, Asn297 is mutated to glutamine (N297Q). Methods for controlling immune response with antibodies that modulate FcγR-regulated signaling are described, for example, in U.S. Patent 7,416,726 and U.S. Patent Application Publications 2007/0014795 and 2008/0286819, which are hereby incorporated by reference in their entireties.

In some embodiments, the antibodies of the immunoconjugates are modified to contain an engineered Fab region with a non-naturally occurring glycosylation pattern. For example, hybridomas can be genetically engineered to secrete afucosylated mAb, desialylated mAb or deglycosylated Fc with specific mutations that enable increased FcRγIIIa binding and effector function. In some embodiments, the antibodies of the immunoconjugates are engineered to be afucosylated.

In some embodiments, the entire Fc region of an antibody in the immunoconjugates is exchanged with a different Fc region, so that the Fab region of the antibody is conjugated to a non-native Fc region. For example, the Fab region of cetuximab, which normally comprises an IgG1 Fc region, can be conjugated to IgG2, IgG3, IgG4, or IgA, or the Fab region of nivolumab, which normally comprises an IgG4 Fc region, can be conjugated to IgG1, IgG2, IgG3, IgA1, or IgG2. In some embodiments, the Fc modified antibody with a non-native Fc domain also comprises one or more amino acid modification, such as the S228P mutation within the IgG4 Fc, that modulate the stability of the Fc domain described. In some embodiments, the Fc modified antibody with a non-native Fc domain also comprises one or more amino acid modifications described herein that modulate Fc binding to FcR.

In some embodiments, the modifications that modulate the binding of the Fc region to FcR do not alter the binding of the Fab region of the antibody to its antigen when compared to the native non-modified antibody. In other embodiments, the modifications that modulate the binding of the Fc region to FcR also increase the binding of the Fab region of the antibody to its antigen when compared to the native non-modified antibody.

In an exemplary embodiment, the immunoconjugates of the invention comprise an antibody construct that comprises an antigen binding domain that specifically recognizes and binds PD-L1.

Programmed Death-Ligand 1 (PD-L1, cluster of differentiation 274, CD274, B7-homolog 1, or B7-H1) belongs to the B7 protein superfamily, and is a ligand of programmed cell death protein 1 (PD-1, PDCD1, cluster of differentiation 279, or CD279). PD-L1 can also interact with B7.1 (CD80) and such interaction is believed to inhibit T cell priming. The PD-L1/PD-1 axis plays a large role in suppressing the adaptive immune response. More specifically, it is believed that engagement of PD-L1 with its receptor, PD-1, delivers a signal that inhibits activation and proliferation of T-cells. Agents that bind to PD-L1 and prevent the ligand from binding to the PD-1 receptor prevent this immunosuppression, and can, therefore, enhance an immune response when desired, such as for the treatment of cancers, or infections. PD-L1/PD-1 pathway also contributes to preventing autoimmunity and therefore agonistic agents against PD-L1 or agents that deliver immune inhibitory payloads may help treatment of autoimmune disorders.

Several antibodies targeting PD-L1 have been developed for the treatment of cancer, including atezolizumab (TECENTRIQ™), durvalumab (IMFINZI™), and avelumab (BAVENCIO™). Nevertheless, there continues to be a need for new PD-L1-binding agents, including agents that bind PD-L1 with high affinity and effectively prevent PD-L1/PD-1 signaling and agents that can deliver therapeutic payloads to PD-L1 expressing cells. In addition, there is a need for new PD-L1-binding agents to treat autoimmune disorders and infections.

A method is provided of delivering a TLR agonist, 2-amino-4-carboxamide-benzazepine payload to a cell expressing PD-L1 comprising administering to the cell, or mammal comprising the cell, an immunoconjugate comprising an anti-PD-L1 antibody covalently attached to a linker which is covalently attached to one or more 2-amino-4-carboxamide-benzazepinemoieties.

Also provided is a method for enhancing or reducing or inhibiting an immune response in a mammal, and a method for treating a disease, disorder, or condition in a mammal that is responsive to PD-L1 inhibition, which methods comprise administering a PD-L1 immunoconjugate thereof, to the mammal.

The invention provides a PD-L1 antibody comprising an immunoglobulin heavy chain variable region polypeptide and an immunoglobulin light chain variable region polypeptide. The PD-L1 antibody specifically binds PD-L1. The binding specificity of the antibody allows for targeting PD-L1 expressing cells, for instance, to deliver therapeutic payloads to such cells. In some embodiments, the PD-L1 antibody binds to human PD-L1. However, antibodies that bind to any PD-L1 fragment, homolog or paralog also are encompassed.

In some embodiments, the PD-L1 antibody binds PD-L1 without substantially inhibiting or preventing PD-L1 from binding to its receptor, PD-1. However, in other embodiments, the

PD-L1 antibody can completely or partially block (inhibit or prevent) binding of PD-L1 to its receptor, PD-1, such that the antibody can be used to inhibit PD-L1/PD-1 signaling (e.g., for therapeutic purposes). The antibody or antigen-binding antibody fragment can be monospecific for PD-L1, or can be bispecific or multi-specific. For instance, in bivalent or multivalent antibodies or antibody fragments, the binding domains can be different targeting different epitopes of the same antigen or targeting different antigens. Methods of constructing multivalent binding constructs are known in the art. Bispecific and multispecific antibodies are known in the art. Furthermore, a diabody, triabody, or tetrabody can be provided, which is a dimer, trimer, or tetramer of polypeptide chains each comprising a V_H connected to a V_L by a peptide linker that is too short to allow pairing between the V_H and V_L on the same polypeptide chain, thereby driving the pairing between the complementary domains on different V_H -V_L polypeptide chains to generate a multimeric molecule having two, three, or four functional antigen binding sites. Also, bis-scFv fragments, which are small scFv fragments with two different variable domains can be generated to produce bispecific bis-scFv fragments capable of binding two different epitopes. Fab dimers (Fab2) and Fab trimers (Fab3) can be produced using genetic engineering methods to create multispecific constructs based on Fab fragments.

The PD-L1 antibody can be, or can be obtained from, a human antibody, a non-human antibody, a humanized antibody, or a chimeric antibody, or corresponding antibody fragments. A “chimeric” antibody is an antibody or fragment thereof typically comprising human constant regions and non-human variable regions. A “humanized” antibody is a monoclonal antibody typically comprising a human antibody scaffold but with non-human origin amino acids or sequences in at least one CDR (e.g., 1, 2, 3, 4, 5, or all six CDRs).

The PD-L1 antibody can be internalizing, as described in WO 2021/150701 and incorporated by reference herein, or the PD-L1 antibody can be non-internalizing, as described in WO 2021/150702 and incorporated by reference herein.

In an exemplary embodiment, the immunoconjugates of the invention comprise an antibody construct that comprises an antigen binding domain that specifically recognizes and binds HER2.

A number of anti-HER2 monoclonal antibodies are approved and under clinical development (Costa, RLB et al (2020) *Breast Cancer* 6(10):1-11.

In certain embodiments, immunoconjugates of the invention comprise an anti-HER2 antibody such as those prepared by the methods of Example 201. In one embodiment of the invention, an anti-HER2 antibody of an immunoconjugate of the invention comprises a humanized anti-HER2 antibody, e.g., huMAb4D5-1, huMAb4D5-2, huMAb4D5-3, huMAb4D5-4, huMAb4D5-5, huMAb4D5-6, huMAb4D5-7 and huMAb4D5-8, as described in

Table 3 of US 5821337, which is specifically incorporated by reference herein. Those antibodies contain human framework regions with the complementarity-determining regions of a murine antibody (4D5) that binds to HER2. The humanized antibody huMAb4D5-8 is also referred to as trastuzumab, commercially available under the tradename HERCEPTIN™ (Genentech, Inc.).

Trastuzumab (CAS 180288-69-1, HERCEPTIN®, huMAb4D5-8, rhuMAb HER2, Genentech) is a recombinant DNA-derived, IgG1 kappa, monoclonal antibody that is a humanized version of a murine anti-HER2 antibody (4D5) that selectively binds with high affinity in a cell-based assay (Kd = 5 nM) to the extracellular domain of HER2 (US 5677171; US 5821337; US 6054297; US 6165464; US 6339142; US 6407213; US 6639055; US 6719971; US 6800738; US 7074404; Coussens et al (1985) Science 230:1132-9; Slamon et al (1989) Science 244:707-12; Slamon et al (2001) New Engl. J. Med. 344:783-792).

In an embodiment of the invention, the antibody construct or antigen binding domain comprises the CDR regions of trastuzumab. In an embodiment of the invention, the anti-HER2 antibody further comprises the framework regions of the trastuzumab. In an embodiment of the invention, the anti-HER2 antibody further comprises one or both variable regions of trastuzumab.

In another embodiment of the invention, an anti-HER2 antibody of an immunoconjugate of the invention comprises a humanized anti-HER2 antibody, e.g., humanized 2C4, as described in US 7862817. An exemplary humanized 2C4 antibody is pertuzumab (CAS Reg. No. 380610-27-5), PERJETA™ (Genentech, Inc.). Pertuzumab is a HER dimerization inhibitor (HDI) and functions to inhibit the ability of HER2 to form active heterodimers or homodimers with other HER receptors (such as EGFR/HER1, HER2, HER3 and HER4). See, for example, Harari and Yarden, Oncogene 19:6102-14 (2000); Yarden and Sliwkowski. Nat Rev Mol Cell Biol 2:127-37 (2001); Sliwkowski Nat Struct Biol 10:158-9 (2003); Cho et al. Nature 421:756-60 (2003); and Malik et al. Pro Am Soc Cancer Res 44:176-7 (2003). PERJETA™ is approved for the treatment of breast cancer.

In an embodiment of the invention, the antibody construct or antigen binding domain comprises the CDR regions of pertuzumab. In an embodiment of the invention, the anti-HER2 antibody further comprises the framework regions of the pertuzumab. In an embodiment of the invention, the anti-HER2 antibody further comprises one or both variable regions of pertuzumab.

Margetuximab (MGAH22, MARGENZA™, MacroGenics, Inc.), CAS Reg. No. 1350624-75-7, is an FDA-approved anti-HER2 monoclonal antibody. The Fc region of margetuximab is optimized for increased binding to the activating Fc gamma Rs but decreased

binding to the inhibitory Fc.gamma.Rs on immune effector cells (Nordstrom, JL, et al (2011) *Breast Cancer Res.* 13(6):R123; Rugo, HS, et al (2021) *JAMA Oncol.*;7(4):573-584; Markham, A. (2021) *Drugs* 81:599–604). Margetuximab is approved by the FDA for treatment of patients with relapsed or refractory advanced breast cancer whose tumors express HER2 at the 2+ level by immunohistochemistry and lack evidence of HER2 gene amplification by FISH.

HT-19 is another anti-HER2 monoclonal antibody that binds to an epitope in human HER2 distinct from the epitope of trastuzumab or pertuzumab. HT-19 was shown to inhibit HER2 signaling comparable to trastuzumab and enhance HER2 degradation in combination with trastuzumab and pertuzumab. XMT-1522 is an antibody-drug conjugate comprising the HT-19 antibody (Bergstrom D. A. et al., (2015) *Cancer Res.*; 75:LB-231).

In an exemplary embodiment, the immunoconjugates of the invention comprise an antibody construct that comprises an antigen binding domain that specifically recognizes and binds CEA. Carcinoembryonic antigen-related cell adhesion molecule 5 (CEACAM5) also known as CD66e (Cluster of Differentiation 66e), is a member of the carcinoembryonic antigen (CEA) gene family.

Elevated expression of carcinoembryonic antigen (CEA, CD66e, CEACAM5) has been implicated in various biological aspects of neoplasia, especially tumor cell adhesion, metastasis, the blocking of cellular immune mechanisms, and having anti-apoptosis functions. CEA is a cell-surface antigen and also is used as a blood marker for many carcinomas. Labetuzumab (CEA-CIDE™, Immunomedics, CAS Reg. No. 219649-07-7), also known as MN-14 and hMN14, is a humanized IgG1 monoclonal antibody and has been studied for the treatment of colorectal cancer (Blumenthal, R. et al (2005) *Cancer Immunology Immunotherapy* 54(4):315-327). Labetuzumab conjugated to a camptothecin analog (labetuzumab govitecan, IMMU-130) targets CEA and is being studied in patients with relapsed or refractory metastatic colorectal cancer (Sharkey, R. et al (2018), *Molecular Cancer Therapeutics* 17(1):196-203; Dotan, E. et al (2017), *Journal of Clinical Oncology* 35(9):3338-3346). Also, labetuzumab conjugated to ^{131}I has been evaluated in clinical trials for the treatment of colon cancer and other solid malignancies (Sharkey, R. et al (1995), *Cancer Research (Suppl.)* 55(23):5935s-5945s; Liersch, T. et al (2005), *Journal of Clinical Oncology* 23(27):6763-6770; Sahlmann, C.-O. et al (2017), *Cancer* 123(4):638-649).

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of hMN-14/labetuzumab SEQ ID NO. 1 as disclosed in US 6676924, which is incorporated by reference herein for this purpose.

DIQLTQSPSSLSASVGDRVTITCKASQDVGTSVAWYQQKPGKAPKLLIYWTSTRHTGVPSRFSGSGSGTD
FTFTISSLQPEDIATYYCQQYSLYRSFGQGTKVEIK SEQ ID NO. 1

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of hMN-14/labetuzumab SEQ ID NO. 2-8 (US 6676924) (full length sequence disclosed as SEQ ID NO: 1).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	DIQLTQSPSSLSASVGDRVTITC	1 - 23	23	2
CDR-L1	KASQDVGTSVA	24 – 34	11	3
LFR2	WYQQKPGKAPKLLIY	35 – 49	15	4
CDR-L2	WTSTRHT	50 – 56	7	5
LFR3	GVPSRFSGSGSGTDFTFTISSLQPEDIATYYC	57 – 88	32	6
CDR-L3	QQYSLYRS	89 – 96	8	7
LFR4	FGQGTKVEIK	97 – 106	10	8

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of hMN-14/labetuzumab SEQ ID NO. 9 as disclosed in US 6676924, which is incorporated by reference herein for this purpose.

EVQLVESGGGVVQPGRSLRLSCSSSGFDFTTYWMSWVRQAPGKGLEWVAEIHPDSSTINYAPSLKDRFTI
SRDNSKNTLFLQMDSLRPEDTGVYFCASLYFGFPWFAYWGQGTPVTVSS SEQ ID NO. 9

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of hMN-14/labetuzumab SEQ ID NO. 10-16 (US 6676924) (full length sequence disclosed as SEQ ID NO: 9).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	EVQLVESGGGVVQPGRSLRLSCSSSGFDFT	1 – 30	30	10
CDR-H1	TYWMS	31 – 35	5	11
HFR2	WVRQAPGKGLEWVA	36 – 49	14	12
CDR-H2	EIHPDSSTINYAPSLKD	50 – 66	17	13
HFR3	RFTISRDNSKNTLFLQMDSLRPEDTGVYFCAS	67 – 98	32	14
CDR-H3	LYFGFPWFAY	99 – 108	10	15

HFR4	WGQGTPVTVSS	109 – 119	11	16

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of hPR1A3 SEQ ID NO. 17 as disclosed in US 8642742, which is incorporated by reference herein for this purpose.

DIQMTQSPSSLSASVGDRVTITCKASAAVGTYVAWYQQKPGKAPKLLIYSASYRKRGVPSRFSGSGSGTD FTLTISSLQPEDFATYYCHQYYTYPLFTFGQGTKLEIK SEQ ID NO. 17

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of hPR1A3 SEQ ID NO. 18-24 (US 8642742) (full length sequence disclosed as SEQ ID NO: 17).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	DIQMTQSPSSLSASVGDRVTITC	1 - 23	23	18
CDR-L1	KASAAVGTYVA	24 - 34	11	19
LFR2	WYQQKPGKAPKLLIY	35 - 49	15	20
CDR-L2	SASYRKR	50 - 56	7	21
LFR3	GVPSRFSGSGSGTDFTLTISSLQPEDFATYYC	57 - 88	32	22
CDR-L3	HQYYTYPLFT	89 - 98	10	23
LFR4	FGQGTKLEIK	99 - 108	10	24

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of hPR1A3 SEQ ID NO. 25-31 (US 8642742) (full length sequence disclosed as SEQ ID NO: 130).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	QVQLVQSGAEVKKPGASVKVSCKASGYTFT	1 - 30	30	25
CDR-H1	EFGMN	31 - 35	5	26
HFR2	WVRQAPGQGLEWMG	36 - 49	14	27
CDR-H2	WINTKTGEATYVEEFKG	50 - 66	17	28
HFR3	RVTFTTDTSTSTAYMELRSLRSDDTAVYYCAR	67 - 98	32	29
CDR-H3	WDFAYYVEAMDY	99 - 110	12	30

HFR4	WGQGTTVTVSS	111 - 121	11	31

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of hMFE-23 SEQ ID NO. 32 as disclosed in US 7232888, which is incorporated by reference herein for this purpose.

ENVLTQSPSSMSASVGDRVNIACSASSSVSYMHWFQQKPGKSPKLWIYSTSNLASGVPSRFSGSGSGTDY SLTISSMQPEDAATYYCQQRSSYPLTFGGGTKLEIK SEQ ID NO. 32

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of hMFE-23 SEQ ID NO. 33-40 (US 7232888). The embodiment includes two variants of LFR1, SEQ ID NO.:33 and SEQ ID NO.:34 (full length sequences disclosed as SEQ ID NOS 32 and 172, respectively, in order of appearance).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	ENVLTQSPSSMSASVGDRVNIAC	1 – 23	23	33
LFR1	EIVLTQSPSSMSASVGDRVNIAC	1 – 23	23	34
CDR-L1	SASSSVSYMH	24 – 33	10	35
LFR2	WFQQKPGKSPKLWIY	34 – 48	15	36
CDR-L2	STSNLAS	49 – 55	7	37
LFR3	GVPSRFSGSGSGTDYSLTISSMQPEDAATYYC	56 – 87	32	38
CDR-L3	QQRSSYPLT	88 – 96	9	39
LFR4	FGGGTKLEIK	97 – 106	10	40

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of hMFE-23 SEQ ID NO. 41 (US 7232888).

QVKLEQSGAEVVKPGASVKLSCKASGFNIKDSYMHWLRQGPGQRLEWIGWIDPENGDTEYAPKFQGKATF TTDTSANTAYLGLSSLRPEDTAVYYCNEGTPTGPYYFDYWGQGTLVTVSS SEQ ID NO. 41

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of hMFE-23 SEQ ID NO. 42-49 (US 7232888). The embodiment includes two variants of HFR1, SEQ ID NO.:42 and SEQ ID NO.:43 (full length sequences disclosed as SEQ ID NOS 41 and 173, respectively, in order of appearance).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	QVKLEQSGAEVVKPGASVKLSCKASGFNIK	1 – 30	30	42
HFR1	QVQLVQSGAEVVKPGASVKLSCKASGFNIK	1 – 30	30	43
CDR-H1	DSYMH	31 – 35	5	44
HFR2	WLRQGPGQRLEWIG	36 - 49	14	45
CDR-H2	WIDPENGDTEYAPKFQG	50 - 66	17	46
HFR3	KATFTTDTSANTAYLGLSSLRPEDTAVYYCNE	67 - 98	32	47
CDR-H3	GTPTGPYYFDY	99 - 109	11	48
HFR4	WGQGTLVTVSS	110 - 120	11	49

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of SM3E SEQ ID NO. 50 (US 7232888).

ENVLTQSPSSMSVSVGDRVTIACSASSSVPYMHWLQQKPGKSPKLLIYLTSNLASGVPSRFSGSGSGTDY SLTISSVQPEDAATYYCQQRSSYPLTFGGGTKLEIK SEQ ID NO. 50

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of SM3E SEQ ID NO. 51-56 and 38-39 (US 7232888). The embodiment includes two variants of LFR1, SEQ ID NO.:51 and SEQ ID NO.:52 (full length sequences disclosed as SEQ ID NOS 50 and 174, respectively, in order of appearance).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	ENVLTQSPSSMSVSVGDRVTIAC	1 - 23	23	51
LFR1	EIVLTQSPSSMSVSVGDRVTIAC	1 - 23	23	52
CDR-L1	SASSSVPYMH	24 - 33	10	53
LFR2	WLQQKPGKSPKLLIY	34 - 48	15	54
CDR-L2	LTSNLAS	49 - 55	7	55
LFR3	GVPSRFSGSGSGTDYSLTISSVQPEDAATYYC	56 - 87	32	56
CDR-L3	QQRSSYPLT	88 - 96	9	39
LFR4	FGGGTKLEIK	97 - 106	10	40

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain of NP-4/arcitumomab SEQ ID NO. 57

QTVLSQSPAILSASPGEKVTMTCRASSSVTYIHWYQQKPGSSPKSWIYATSNLASGVPARFSGSGSGTSY
SLTISRVEAEDAATYYCQHWSSKPPTFGGGTKLEIK SEQ ID NO. 57

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of NP-4/arcitumomab SEQ ID NO. 58-64 (full length sequence disclosed as SEQ ID NO: 57).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	QTVLSQSPAILSASPGEKVTMTC	1 – 23	23	58
CDR-L1	RASSSVTYIH	24 – 33	10	59
LFR2	WYQQKPGSSPKSWIY	34 – 48	15	60
CDR-L2	ATSNLAS	49 – 55	7	61
LFR3	GVPARFSGSGSGTSYSLTISRVEAEDAATYYC	56 – 87	32	62
CDR-L3	QHWSSKPPT	88 – 96	9	63
LFR4	FGGGTKLEIK	97 – 106	10	64

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of NP-4/arcitumomab SEQ ID NO. 65.

EVKLVESGGGLVQPGGSLRLSCATSGFTFTDYYMNWVRQPPGKALEWLGFIGNKANGYTTEYSASVKGRF
TISRDKSQSILYLQMNTLRAEDSATYYCTRDRGLRFYFDYWGQGTTLTVSS SEQ ID NO. 65.

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of NP-4 SEQ ID NO. 66-72 (full length sequence disclosed as SEQ ID NO: 65).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	EVKLVESGGGLVQPGGSLRLSCATSGFTFT	1 – 30	30	66
CDR-H1	DYYMN	31 – 35	5	67
HFR2	WVRQPPGKALEWLG	36 – 49	14	68

CDR-H2	FIGNKANGYTTEYSASVKG	50 – 68	19	69
HFR3	RFTISRDKSQSILYLQMNTLRAEDSATYYCTR	69 – 100	32	70
CDR-H3	DRGLRFYFDY	101 – 110	10	71
HFR4	WGQGTTLTVSS	111 – 121	11	72

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of M5A/hT84.66 SEQ ID NO. 73 as disclosed in US 7776330, which is incorporated by reference herein for this purpose.

DIQLTQSPSSLSASVGDRVTITCRAGESVDIFGVGFLHWYQQKPGKAPKLLIYRASNLESGVPSRFSGSG
SRTDFTLTISSLQPEDFATYYCQQTNEDPYTFGQGTKVEIK SEQ ID NO. 73

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of M5A/hT84.66 SEQ ID NO. 74-80 (US 7776330) (full length sequence disclosed as SEQ ID NO: 73).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	DIQLTQSPSSLSASVGDRVTITC	1 - 23	23	74
CDR-L1	RAGESVDIFGVGFLH	24 - 38	15	75
LFR2	WYQQKPGKAPKLLIY	39 - 53	15	76
CDR-L2	RASNLES	54 - 60	7	77
LFR3	GVPSRFSGSGSRTDFTLTISSLQPEDFATYYC	61 - 92	32	78
CDR-L3	QQTNEDPYT	93 - 101	9	79
LFR4	FGQGTKVEIK	102 - 111	10	80

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of M5A/hT84.66 SEQ ID NO. 81 (US 7776330).

EVQLVESGGGLVQPGGSLRLSCAASGFNIKDTYMHWVRQAPGKGLEWVARIDPANGNSKYADSVKGRFTI
SADTSKNTAYLQMNSLRAEDTAVYYCAPFGYYVSDYAMAYWGQGTLVTVSS SEQ ID NO. 81

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of M5A/hT84.66 SEQ ID NO. 82-88 (US 7776330) (full length sequence disclosed as SEQ ID NO: 81).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	EVQLVESGGGLVQPGGSLRLSCAASGFNIK	1 - 30	30	82
CDR-H1	DTYMH	31 - 35	5	83
HFR2	WVRQAPGKGLEWVA	36 - 49	14	84
CDR-H2	RIDPANGNSKYADSVKG	50 – 66	17	85
HFR3	RFTISADTSKNTAYLQMNSLRAEDTAVYYCAP	67 – 98	32	86
CDR-H3	FGYYVSDYAMAY	99 – 110	12	87
HFR4	WGQGTLVTVSS	111 – 121	11	88

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of hAb2-3 SEQ ID NO. 89 as disclosed in US 9617345, which is incorporated by reference herein for this purpose.

DIQMTQSPASLSASVGDRVTITCRASENIFSYLAWYQQKPGKSPKLLVYNTRTLAEGVPSRFSGSGSGTD
FSLTISSLQPEDFATYYCQHHYGTPFTFGSGTKLEIK SEQ ID NO. 89

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of hAb2-3 SEQ ID NO. 90-96 (US 9617345) (full length sequence disclosed as SEQ ID NO: 89).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	DIQMTQSPASLSASVGDRVTITC	1 – 23	23	90
CDR-L1	RASENIFSYLA	24 – 34	11	91
LFR2	WYQQKPGKSPKLLVY	35 – 49	15	92
CDR-L2	NTRTLAE	50 – 56	7	93
LFR3	GVPSRFSGSGSGTDFSLTISSLQPEDFATYYC	57 – 88	32	94
CDR-L3	QHHYGTPFT	89 – 97	9	95
LFR4	FGSGTKLEIK	98 – 107	10	96

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of SEQ ID NO. 97 (US 9617345).

EVQLQESGPGLVKPGGSLSLSCAASGFVFSSYDMSWVRQTPERGLEWVAYISSGGGITYAPSTVKGRFTV
SRDNAKNTLYLQMNSLTSEDTAVYYCAAHYFGSSGPFAYWGQGTLVTVSS SEQ ID NO. 97

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of hAb2-3 SEQ ID NO. 98-104 (full length sequence disclosed as SEQ ID NO: 97).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	EVQLQESGPGLVKPGGSLSLSCAASGFVFS	1 - 30	30	98
CDR-H1	SYDMS	31 - 35	5	99
HFR2	WVRQTPERGLEWVA	36 - 49	14	100
CDR-H2	YISSGGGITYAPSTVKG	50 - 66	17	101
HFR3	RFTVSRDNAKNTLYLQMNSLTSEDTAVYYCAA	67 - 98	32	102
CDR-H3	HYFGSSGPFAY	99 - 109	11	103
HFR4	WGQGTLVTVSS	110 - 120	11	104

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable light chain (VL kappa) of A240VL-B9VH/AMG-211 SEQ ID NO. 105 as disclosed in US 9982063, which is incorporated by reference herein for this purpose.

QAVLTQPASLSASPGASASLTCTLRRGINVGAYSIYWYQQKPGSPPQYLLRYKSDSDKQQGSGVSSRFSA
SKDASANAGILLISGLQSEDEADYYCMIWHSGASAVFGGGTKLTVL SEQ ID NO. 105

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) or light chain framework (LFR) sequences of A240VL-B9VH/AMG-211 SEQ ID NO. 106-112 (US 9982063) (full length sequence disclosed as SEQ ID NO: 105).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
LFR1	QAVLTQPASLSASPGASASLTC	1 - 22	22	106
CDR-L1	TLRRGINVGAYSIY	23 - 36	14	107
LFR2	WYQQKPGSPPQYLLR	37 - 51	15	108
CDR-L2	YKSDSDKQQGS	52 - 62	11	109
LFR3	GVSSRFSASKDASANAGILLISGLQSEDEADYYC	63 - 96	34	110
CDR-L3	MIWHSGASAV	97 - 106	10	111

LFR4	FGGGTKLTVL	107 - 116	10	112

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of B9VH SEQ ID NO. 113 (US 9982063).

EVQLVESGGGLVQPGRSLRLSCAASGFTVSSYWMHWVRQAPGKGLEWVGFIRNKANGGTTEYAASVKGRF
TISRDDSKNTLYLQMNSLRAEDTAVYYCARDRGLRFYFDYWGQGTTVTVSS SEQ ID NO. 113

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of SEQ ID NO. 114-121 (US 9982063). The embodiment includes two variants of CDR-H2, SEQ ID NO.:117 and SEQ ID NO.:118 (full length sequences disclosed as SEQ ID NOS 113 and 175, respectively, in order of appearance).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.
HFR1	EVQLVESGGGLVQPGRSLRLSCAASGFTVS	1 – 30	30	114
CDR-H1	SYWMH	31 – 35	5	115
HFR2	WVRQAPGKGLEWVG	36 – 49	14	116
CDR-H2	FIRNKANGGTTEYAASVKG	50 – 68	19	117
CDR-H2	FIRNKANSGTTEYAASVKG	50 – 68	19	118
HFR3	RFTISRDDSKNTLYLQMNSLRAEDTAVYYCAR	69 – 100	32	119
CDR-H3	DRGLRFYFDY	101 - 110	10	120
HFR4	WGQGTTVTVSS	111 - 121	11	121

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of E12VH SEQ ID NO. 122 (US 9982063).

EVQLVESGGGLVQPGRSLRLSCAASGFTVSSYWMHWVRQAPGKGLEWVGFILNKANGGTTEYAASVKGRF
TISRDDSKNTLYLQMNSLRAEDTAVYYCARDRGLRFYFDYWGQGTTVTVSS SEQ ID NO. 122

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) or heavy chain framework (HFR) sequences of SEQ ID NO. 123-129 (US 9982063) (full length sequence disclosed as SEQ ID NO: 122).

Region	Sequence Fragment	Residues	Length	SEQ ID NO.

HFR1	EVQLVESGGGLVQPGRSLRLSCAASGFTVS	1 – 30	30	123
CDR-H1	SYWMH	31 - 35	5	124
HFR2	WVRQAPGKGLEWVG	36 - 49	14	125
CDR-H2	FILNKANGGTTEYAASVKG	50 - 68	19	126
HFR3	RFTISRDDSKNTLYLQMNSLRAEDTAVYYCAR	69 - 100	32	127
CDR-H3	DRGLRFYFDY	101 - 110	10	128
HFR4	WGQGTTVTVSS	111 - 121	11	129

In an embodiment of the invention, the CEA-targeting antibody construct or antigen binding domain comprises the Variable heavy chain (VH) of PR1A3 VH SEQ ID NO. 130 (US 8642742).

QVQLVQSGAEVKKPGASVKVSCKASGYTFTEFGMNWVRQAPGQGLEWMGWINTKTGEATYVEEFKGRVTF TTDTSTSTAYMELRSLRSDDTAVYYCARWDFAYYVEAMDYWGQGTTVTVSS SEQ ID NO. 130

In an exemplary embodiment, the immunoconjugates of the invention comprise an antibody construct that comprises an antigen binding domain that specifically recognizes and binds TROP2.

Tumor-associated calcium signal transducer 2 (TROP2) is a transmembrane glycoprotein encoded by the TACSTD2 gene (Linnenbach AJ, et al (1993) *Mol Cell Biol.* 13(3): 1507–15; Calabrese G, et al (2001) *Cytogenet Cell Genet.* 92(1–2): 164–5). It is an intracellular calcium signal transducer that is differentially expressed in many cancers. It signals cells for self-renewal, proliferation, invasion, and survival. It has stem cell-like qualities. TROP2 is expressed in many normal tissues, though in contrast, it is overexpressed in many cancers (Ohmachi T, et al., (2006) *Clin. Cancer Res.*, 12(10), 3057-3063; Muhlmann G, et al., (2009) *J. Clin. Pathol.*, 62(2), 152-158; Fong D, et al., (2008) *Br. J. Cancer*, 99(8), 1290-1295; Fong D, et al., (2008) *Mod. Pathol.*, 21(2), 186-191; Ning S, et al., (2013) *Neurol. Sci.*, 34(10), 1745-1750). Overexpression of TROP2 is of prognostic significance. Several ligands have been proposed that interact with TROP2. TROP2 signals the cells via different pathways and it is transcriptionally regulated by a complex network of several transcription factors.

Human TROP2 (TACSTD2: tumor-associated calcium signal transducer 2, GA733-1, EGP-1, M1S1; hereinafter, referred to as hTROP2) is a single-pass transmembrane type 1 cell membrane protein consisting of 323 amino acid residues. While the presence of a cell membrane protein involved in immune resistance, which is common to human trophoblasts and cancer cells (Faulk W P, et al. (1978), *Proc. Natl. Acad. Sci.* 75(4):1947-1951), has previously been

suggested, an antigen molecule recognized by a monoclonal antibody against a cell membrane protein in a human choriocarcinoma cell line was identified and designated as TROP2 as one of the molecules expressed in human trophoblasts (Lipinski M, et al. (1981), *Proc. Natl. Acad. Sci.* 78(8), 5147-5150). This molecule was also designated as tumor antigen GA733-1 recognized by a mouse monoclonal antibody GA733 (Linnenbach A J, et al., (1989) *Proc. Natl. Acad. Sci.* 86(1), 27-31) obtained by immunization with a gastric cancer cell line or an epithelial glycoprotein (EGP-1; Basu A, et al., *Int. J. Cancer*, 62 (4), 472-479 (1995)) recognized by a mouse monoclonal antibody RS7-3G11 obtained by immunization with non-small cell lung cancer cells. In 1995, however, the TROP2 gene was cloned, and all of these molecules were confirmed to be identical molecules (Fornaro M, et al., (1995) *Int. J. Cancer*, 62(5), 610-618). The DNA sequence and amino acid sequence of hTROP2 are available on a public database and can be referred to, for example, under Accession Nos. NM_002353 and NP_002344 (NCBI).

In response to such information suggesting the association with cancer, a plurality of anti-hTROP2 antibodies have been established so far and studied for their antitumor effects. Among these antibodies, there is disclosed, for example, an unconjugated antibody that exhibits in itself antitumor activity in nude mouse xenograft models (WO 2008/144891; WO 2011/145744; WO 2011/155579; WO 2013/077458) as well as an antibody that exhibits antitumor activity as ADC with a cytotoxic drug (WO 2003/074566; WO 2011/068845; WO 2013/068946; US 7,999,083). However, the strength or coverage of their activity is still insufficient, and there are unsatisfied medical needs for hTROP2 as a therapeutic target.

TROP2 expression in cancer cells has been correlated with drug resistance. Several strategies target TROP2 on cancer cells that include antibodies, antibody fusion proteins, chemical inhibitors, nanoparticles, etc. The in vitro studies and pre-clinical studies, using these various therapeutic treatments, have resulted in significant inhibition of tumor cell growth both in vitro and in vivo in mice. Clinical studies have explored the potential application of Trop2 as both a prognostic biomarker and as a therapeutic target to reverse resistance.

Sacituzumab govitecan (TRODELVY®, Immunomedics, IMMU-132), an antibody-drug conjugate comprising a TROP2-directed antibody linked to a topoisomerase inhibitor drug, is indicated for the treatment of metastatic triple-negative breast cancer (mTNBC) in adult patients that have received at least two prior therapies. The TROP2 antibody in sacituzumab govitecan is conjugated to SN-38, the active metabolite of irinotecan (US 2016/0297890; WO 2015/098099).

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) sequences of hRS7 (humanized RS7), SEQ ID NO:131-133 (US 7238785; US 7420040 incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-L1	KASQDVSIAVA	131
CDR-L2	SASYRYT	132
CDR-L3	QQHYITPLT	133

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences of hRS7 (humanized RS7), SEQ ID NO:134-136 (US 7238785; US 9797907; US 9382329; WO 2020/142659, each incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	NYGMN	134
CDR-H2	WINTYTGEPTYTDDFKG	135
CDR-H3	GGFGSSYWYFDV	136

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences of AR47A6.4.2, SEQ ID NO:134, 137, 138 (US 7420040, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	NYGMN	134
CDR-H2	WINTKTGEPTYAEEFKG	137
CDR-H3	GGYGSSYWYFDV	138

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) sequences of humanized KM4097, SEQ ID NO:139-141 (US 2012/0237518, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-L1	KSSQSLLNSGNQQNYLA	139

CDR-L2	GASTRES	140
CDR-L3	QSDHIYPYT	141

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences of humanized KM4097, SEQ ID NO:142-144 (US 2012/0237518, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	IYWLG	142
CDR-H2	NIFPGSAYINYNEKFKG	143
CDR-H3	EGSNSGY	144

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) sequences of hTINA1-H1L1, SEQ ID NO:132, 133, 145 (US 10,227,417, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-L1	KASQDVSTAVA	145
CDR-L2	SASYRYT	132
CDR-L3	QQHYITPLT	133

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences of hTINA1-H1L1, SEQ ID NO:146-148 (US 10,227,417, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	TAGMQ	146
CDR-H2	WINTHSGVPKYAEDFKG	147
CDR-H3	SGFGSSYWYFDV	148

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) sequences of hTINA1-H1L1, SEQ ID NO:149-151 (US 8871908, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-L1	RASKSVSTS(X1)YSYMH where X1 is G, L, or N	149
CDR-L2	LASNLES	150
CDR-L3	QHSRELPYT	151

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences of hTINA1-H1L1, SEQ ID NO:152-157 (US 8871908, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	SYGVH	152
CDR-H1	GGSISSY	153
CDR-H1	GGSISSYGVH	154
CDR-H2	VIWT(X1)G(X2)TDYNSALM(X3) where X1 is G or S; X2 is S or V; X3 is S or G	155
CDR-H2	WT(X1)G(X2) where X1 is G or S; X2 is S or V	156
CDR-H3	DGDYDRYTMDY	157

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the light chain CDR (complementarity determining region) sequences SEQ ID NO:150, 151, 158 of hTINA1-H1L1, (US 8871908, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-L1	RASKSVSTSGYSYMH	158
CDR-L2	LASNLES	150
CDR-L3	QHSRELPYT	151

In an embodiment of the invention, the TROP2-targeting antibody construct or antigen binding domain comprises the heavy chain CDR (complementarity determining region) sequences SEQ ID NO:152-154, 157, 159, 160 of hTINA1-H1L1, (US 8871908, incorporated by reference herein).

Region	CDR Sequence Fragment	SEQ ID NO:
CDR-H1	SYGVH	152
CDR-H1	GGSISSY	153
CDR-H1	GGSISSYGVH	154
CDR-H2	VIWTSGVTDYNSALMG	159
CDR-H2	WTSGV	160
CDR-H3	DGDYDRYTMDY	157

In an embodiment of the invention, an immunoconjugate comprises a cysteine-mutant, antibody with a light chain sequence selected from SEQ ID NO: 161-163.

Sequence:	mutant site	SEQ ID NO:
KADYECHKVYA	LC K188C	161
YEKHKCYACEV	LC V191C	162
QLKSGCASVVC	LC T129C	163

In an embodiment of the invention, a cysteine-mutant, TROP2-targeting antibody comprises the heavy chain (HC) of SEQ ID NO:164.

QVQLQQSGSELKKPGASVKVSCKASGYTFTNYGMNWVKQAPGQGLKWMGWINTYTGEPTYTDDFKGRF
AFSLDTSVSTAYLQISSLKADDTAVYFCARGGFGSSYWYFDVWGQGSLVTVSSASTKGPSVFPLAPSSKST
SGGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTYICNVNHKP
SNTKVDKRVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNW
YVDGVEVHNAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREP
QVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSR
WQQGNVFSCSVMHEALHNHYTQKSLSLSPGK

SEQ ID NO. 164

In an embodiment of the invention, the light chain (LC) of a TROP2-targeting antibody is selected from SEQ ID NO:165-167.

Heavy chain	Cys Mutant site	SEQ ID NO:
DIQLTQSPSSLSASVGDRVSITCKASQDVSIAVAWYQQKPGKAPKLLI YSASYRYTGVPDRFSGSGSGTDFTLTISSLQPEDFAVYYCQQHYITPL TFGAGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREA KVQWKVDNALQSGNSQESVTEQDSKDSTYSLSSTLTLSKADYECHK VYACEVTHQGLSSPVTKSFNRGEC	LC K188C	165
DIQLTQSPSSLSASVGDRVSITCKASQDVSIAVAWYQQKPGKAPKLLI YSASYRYTGVPDRFSGSGSGTDFTLTISSLQPEDFAVYYCQQHYITPL TFGAGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREA KVQWKVDNALQSGNSQESVTEQDSKDSTYSLSSTLTLSKADYEKHK CYACEVTHQGLSSPVTKSFNRGEC	LC V191C	166
DIQLTQSPSSLSASVGDRVSITCKASQDVSIAVAWYQQKPGKAPKLLI YSASYRYTGVPDRFSGSGSGTDFTLTISSLQPEDFAVYYCQQHYITPL TFGAGTKVEIKRTVAAPSVFIFPPSDEQLKSGCASVVCLLNNFYPREA KVQWKVDNALQSGNSQESVTEQDSKDSTYSLSSTLTLSKADYEKHK VYACEVTHQGLSSPVTKSFNRGEC	LC T129C	167

In an embodiment of the invention, an immunoconjugate comprises a cysteine-mutant, antibody with a heavy chain sequence of SEQ ID NO:168.

Sequence:	Cys mutant site	SEQ ID NO:
TVSSACTKGPS	HC S119C	168

In an embodiment of the invention, the light chain (LC) of a cysteine-mutant, TROP2-targeting antibody has the sequence of SEQ ID NO:169.

DIQLTQSPSSLSASVGDRVSITCKASQDVSIAVAWYQQKPGKAPKLLIYSASYRYTGVPDRFSGSGSGTDFT
LTISSLQPEDFAVYYCQQHYITPLTFGAGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREAK
VQWKVDNALQSGNSQESVTEQDSKDSTYSLSSTLTLSKADYEKHKVYACEVTHQGLSSPVTKSFNRGEC

SEQ ID NO:169

In an embodiment of the invention, the heavy chain (HC) of a cysteine-mutant, TROP2-targeting antibody has the sequence of SEQ ID NO:170.

QVQLVQSGAEVKKPGASVKVSCKASGDTFTNHYMHWVRQAPGQGLEWMGWINPNSGHTGYAQKFQGR
VTMTRDTSTSTVYMELSSLRSEDTAVYYCAREAVAGPMDVWGQGTTVTVSSA**C**TKGPSVFPLAPSSKSTS
GGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTYICNVNHKPS

NTKVDKRVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWY
VDGVEVHNAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQ
VYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRW
QQGNVFSCSVMHEALHNHYTQKSLSLSPGK

SEQ ID NO:170

In some embodiments, the antibody construct further comprises an Fc domain. In certain embodiments, the antibody construct is an antibody. In certain embodiments, the antibody construct is a fusion protein. The antigen binding domain can be a single-chain variable region fragment (scFv). A single-chain variable region fragment (scFv), which is a truncated Fab fragment including the variable (V) domain of an antibody heavy chain linked to a V domain of a light antibody chain via a synthetic peptide, can be generated using routine recombinant DNA technology techniques. Similarly, disulfide-stabilized variable region fragments (dsFv) can be prepared by recombinant DNA technology. The antibody construct or antigen binding domain may comprise one or more variable regions (e.g., two variable regions) of an antigen binding domain of an anti-PD-L1 antibody, an anti-HER2 antibody, or an anti-CEA antibody, each variable region comprising a CDR1, a CDR2, and a CDR3.

In some embodiments, the antibodies in the immunoconjugates contain a modified Fc region, wherein the modification modulates the binding of the Fc region to one or more Fc receptors.

In some embodiments, the Fc region is modified by inclusion of a transforming growth factor beta 1 (TGFβ1) receptor, or a fragment thereof, that is capable of binding TGFβ1. For example, the receptor can be TGFβ receptor II (TGFβRII). In some embodiments, theTGFβ receptor is a human TGFβ receptor. In some embodiments, the IgG has a C-terminal fusion to a TGFβRII extracellular domain (ECD) as described in US 9676863, incorporated herein. An "Fc linker" may be used to attach the IgG to the TGFβRII extracellular domain, for example, a G_4S_4G Fc linker (SEQ ID NO: 171). The Fc linker may be a short, flexible peptide that allows for the proper three-dimensional folding of the molecule while maintaining the binding-specificity to the targets. In some embodiments, the N-terminus of the TGFβ receptor is fused to the Fc of the antibody construct (with or without an Fc linker). In some embodiments, the C-terminus of the antibody construct heavy chain is fused to the TGFβ receptor (with or without an Fc linker). In some embodiments, the C-terminal lysine residue of the antibody construct heavy chain is mutated to alanine.

In some embodiments, the antibodies in the immunoconjugates are glycosylated.

In some embodiments, the antibody of the immunoconjugate is a cysteine-engineered antibody which provides for site-specific conjugation of an adjuvant to the antibody through

cysteine substitutions at sites where the engineered cysteines are available and reactive for conjugation but do not perturb immunoglobulin folding and assembly or alter antigen binding and effector functions (Junutula, et al., 2008b Nature Biotech., 26(8):925-932; Dornan et al. (2009) Blood 114(13):2721-2729; US 7521541; US 7723485; US 2012/0121615; WO 2009/052249). A "cysteine engineered antibody" or "cysteine engineered antibody variant" is an antibody in which one or more residues of an antibody are substituted with cysteine residues. Cysteine-engineered antibodies can be conjugated to a thiol-reactive electrophilic group such as maleimide on the 2-amino-4-carboxamide-benzazepine-linker compound (Formula II) with uniform stoichiometry (e.g., up to two 2-amino-4-carboxamide-benzazepinemoieties per antibody in an antibody that has a single engineered cysteine site).

In some embodiments, cysteine-engineered antibodies are used to prepare immunoconjugates. Immunoconjugates may have a reactive cysteine thiol residue introduced at a site on the light chain, such as the 149-lysine site (LC K149C), or on the heavy chain such as the 122-serine site (HC S122C), as numbered by Kabat numbering. In other embodiments, the cysteine-engineered antibodies have a cysteine residue introduced at the 118-alanine site (EU numbering) of the heavy chain (HC A118C). This site is alternatively numbered 121 by Sequential numbering or 114 by Kabat numbering. In other embodiments, the cysteine-engineered antibodies have a cysteine residue introduced in: (i) the light chain at G64C, R142C, K188C, L201C, T129C, S114C, or E105C according to Kabat numbering; (ii) the heavy chain at D101C, V184C, T205C, or S122C according to Kabat numbering; or (iii) other cysteine-mutant antibodies, and as described in Bhakta, S. et al, (2013) "Engineering THIOMABs for Site-Specific Conjugation of Thiol-Reactive Linkers", Laurent Ducry (ed.), Antibody-Drug Conjugates, Methods in Molecular Biology, vol. 1045, pages 189-203; WO 2011/156328; US 9000130.

2-AMINO-4-CARBOXAMIDE-BENZAZEPINE ADJUVANT COMPOUNDS

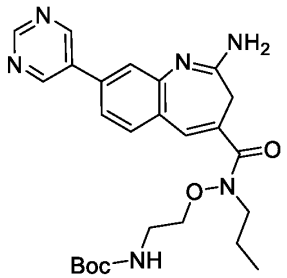
The immunoconjugate of the invention comprises a 2-amino-4-carboxamide-benzazepine adjuvant moiety. The adjuvant moiety described herein is a compound that elicits an immune response (i.e., an immunostimulatory agent). Generally, the adjuvant moiety described herein is a TLR agonist. TLRs are type-I transmembrane proteins that are responsible for the initiation of innate immune responses in vertebrates. TLRs recognize a variety of pathogen-associated molecular patterns from bacteria, viruses, and fungi and act as a first line of defense against invading pathogens. TLRs elicit overlapping yet distinct biological responses due to differences in cellular expression and in the signaling pathways that they initiate. Once engaged (e.g., by a natural stimulus or a synthetic TLR agonist), TLRs initiate a signal transduction cascade leading

to activation of nuclear factor-κB (NF-κB) via the adapter protein myeloid differentiation primary response gene 88 (MyD88) and recruitment of the IL-1 receptor associated kinase (IRAK). Phosphorylation of IRAK then leads to recruitment of TNF-receptor associated factor 6 (TRAF6), which results in the phosphorylation of the NF-κB inhibitor I-κB. As a result, NF-κB enters the cell nucleus and initiates transcription of genes whose promoters contain NF-κB binding sites, such as cytokines. Additional modes of regulation for TLR signaling include TIR-domain containing adapter-inducing interferon-β (TRIF)-dependent induction of TNF-receptor associated factor 6 (TRAF6) and activation of MyD88 independent pathways via TRIF and TRAF3, leading to the phosphorylation of interferon response factor three (IRF3). Similarly, the MyD88 dependent pathway also activates several IRF family members, including IRF5 and IRF7 whereas the TRIF dependent pathway also activates the NF-κB pathway.

Typically, the adjuvant moiety described herein is a TLR7 and/or TLR8 agonist. TLR7 and TLR8 are both expressed in monocytes and dendritic cells. In humans, TLR7 is also expressed in plasmacytoid dendritic cells (pDCs) and B cells. TLR8 is expressed mostly in cells of myeloid origin, i.e., monocytes, granulocytes, and myeloid dendritic cells. TLR7 and TLR8 are capable of detecting the presence of "foreign" single-stranded RNA within a cell, as a means to respond to viral invasion. Treatment of TLR8-expressing cells, with TLR8 agonists can result in production of high levels of IL-12, IFN-γ, IL-1, TNF-α, IL-6, and other inflammatory cytokines. Similarly, stimulation of TLR7-expressing cells, such as pDCs, with TLR7 agonists can result in production of high levels of IFN-α and other inflammatory cytokines. TLR7/TLR8 engagement and resulting cytokine production can activate dendritic cells and other antigen-presenting cells, driving diverse innate and acquired immune response mechanisms leading to tumor destruction.

Exemplary compounds (2Am4CBza) of the invention are shown in Table 1. Each compound was characterized by mass spectrometry and shown to have the mass indicated. Activity against HEK293 NFKB reporter cells expressing human TLR7 or human TLR8 was measured according to Example 203.

Table 1 2-amino-4-carboxamide-benzazepine compounds (2Am4CBza)

2Am4CBza No.	Structure	MW
2Am4CBza-1		480.6

2-AMINO-4-CARBOXAMIDE-BENZAZEPINE-LINKER COMPOUNDS

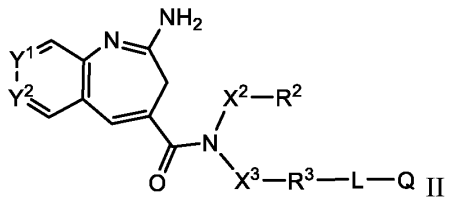
The immunoconjugates of the invention are prepared by conjugation of an antibody with a 2-amino-4-carboxamide-benzazepine-linker compound. The 2-amino-4-carboxamide-benzazepine-linker compounds comprise a 2-amino-4-carboxamide-benzazepine (2Am4CBza) moiety covalently attached to a linker unit, L and a reactive electrophilic group, Q. The linker units comprise functional groups and subunits which affect stability, permeability, solubility, and other pharmacokinetic, safety, and efficacy properties of the immunoconjugates. The linker unit includes a reactive functional group which reacts, i.e. conjugates, with a reactive functional group of the antibody. For example, a nucleophilic group such as a lysine side chain amino of the antibody reacts with an electrophilic reactive functional group of the 2Am4CBza-linker compound to form the immunoconjugate (IC). Also, for example, a cysteine thiol of the antibody reacts with a maleimide or bromoacetamide group of the 2Am4CBza-linker compound to form the immunoconjugate.

Electrophilic reactive functional groups (Q in Formula II) suitable for the 2Am4CBza-linker compounds include, but are not limited to, N-hydroxysuccinimidyl (NHS) esters and N-hydroxysulfosuccinimidyl (sulfo-NHS) esters (amine reactive); carbodiimides (amine and carboxyl reactive); hydroxymethyl phosphines (amine reactive); maleimides (thiol reactive); halogenated acetamides such as *N*-iodoacetamides (thiol reactive); aryl azides (primary amine reactive); fluorinated aryl azides (reactive via carbon-hydrogen (C-H) insertion); pentafluorophenyl (PFP) esters (amine reactive); tetrafluorophenyl (TFP), or sulfotetrafluorophenyl (SulfoTFP) esters (amine reactive); imidoesters (amine reactive); isocyanates (hydroxyl reactive); vinyl sulfones (thiol, amine, and hydroxyl reactive); pyridyl disulfides (thiol reactive); and benzophenone derivatives (reactive via C-H bond insertion).

Further reagents include, but are not limited, to those described in Hermanson, *Bioconjugate Techniques* 2nd Edition, Academic Press, 2008.

The invention provides solutions to the limitations and challenges to the design, preparation and use of immunoconjugates. Some linkers may be labile in the blood stream, thereby releasing unacceptable amounts of the adjuvant/drug prior to internalization in a target cell (Khot, A. et al (2015) Bioanalysis 7(13):1633–1648). Other linkers may provide stability in the bloodstream, but intracellular release effectiveness may be negatively impacted. Linkers that provide for desired intracellular release typically have poor stability in the bloodstream. Alternatively stated, bloodstream stability and intracellular release are typically inversely related. In addition, in standard conjugation processes, the amount of adjuvant/drug moiety loaded on the antibody, i.e. drug loading, the amount of aggregate that is formed in the conjugation reaction, and the yield of final purified conjugate that can be obtained are interrelated. For example, aggregate formation is generally positively correlated to the number of equivalents of adjuvant/drug moiety and derivatives thereof conjugated to the antibody. Under high drug loading, formed aggregates must be removed for therapeutic applications. As a result, drug loading-mediated aggregate formation decreases immunoconjugate yield and can render process scale-up difficult.

Exemplary embodiments of a 2-amino-4-carboxamide-benzazepine-linker compound includes Formula II:



II

wherein

X^2 and X^3 are independently selected from the group consisting of a bond, C(=O), C(=O)N(R^5), O, N(R^5), S, $S(O)_2$, and $S(O)_2N(R^5)$;

Y^1 is CR^1 or N;

Y^2 is CH or N;

R^1 is selected from the group consisting of H, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^2 is selected from the group consisting of H, C_1-C_{12} alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^3 is selected from the group consisting of:

–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=O)*;

–(C_1-C_{12} alkyldiyl)–O–*;

–(C_1-C_{12} alkyldiyl)–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–NR^5–C(=NR^{5a})–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–*;

–(C_6-C_{20} aryldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_2-C_9 heterocyclyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*; and

–(C_1-C_{20} heteroaryldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

where the asterisk * indicates the attachment site of the linker L;

R^5 is selected from the group consisting of H, C_6-C_{20} aryl and C_1-C_{12} alkyl, or two R^5 groups together form a 5- or 6-membered heterocyclyl ring;

R^{5a} is selected from the group consisting of C_6-C_{20} aryl and C_1-C_{20} heteroaryl;

L–Q is selected from the group consisting of:

Q–C(=O)–PEG–C(=O)–;

Q–C(=O)–PEG–C(=O)–PEP–;

Q–C(=O)–PEG–N(R^5)–;

Q–C(=O)–PEG–N(R^5)–C(=O)–;

Q–C(=O)–PEG–NR^5–PEG–C(=O)–PEP–;

Q–C(=O)–PEG–N^+(R^5)$_2$–PEG–C(=O)–PEP–;

Q–C(=O)–PEG–NR^5CH(AA_1)C(=O)–PEG–C(=O)–PEP–;

Q–C(=O)–PEG–O–;

Q–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–OC(=O)–;

Q–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–C(=O)–;

Q–C(=O)–PEG–;

Q–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

Q–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–;

Q–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–;

Q–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

Q–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=O);

Q–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

Q–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–;

Q–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

Q–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–;

Q–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

Q–C(=O)–PEG–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

Q–C(=O)–PEG–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

Q–(CH_2)$_m$–C(=O)–PEP–N(R^5)–;

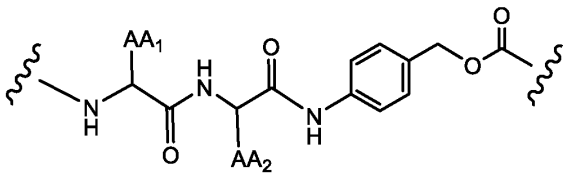
Q–(CH_2)$_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

Q–(CH_2)$_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–; and

Q–(CH_2)$_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

PEG has the formula: $-(CH_2CH_2O)_n-(CH_2)_m-$ where m is an integer from 1 to 5, and n is an integer from 2 to 50;

PEP has the formula:



where AA_1 and AA_2 are independently selected from an amino acid side chain, or AA_1 or AA_2 and an adjacent nitrogen atom form a 5-membered ring proline amino acid, and the wavy line indicates a point of attachment; and

Q is selected from the group consisting of N-hydroxysuccinimidyl, N-hydroxysulfosuccinimidyl, maleimide, and phenoxy substituted with one or more groups independently selected from F, Cl, NO_2, and SO_3^-;

where alkyl, alkyldiyl, alkenyl, alkenyldiyl, alkynyl, alkynyldiyl, aryl, aryldiyl carbocyclyl, carbocyclyldiyl, heterocyclyl, heterocyclyldiyl, heteroaryl, and heteroaryldiyl are optionally substituted with one or more groups independently selected from F, Cl, Br, I, –CN, $-CH_3$, $-CH_2CH_3$, $-CH{=}CH_2$, $-C{\equiv}CH$, $-C{\equiv}CCH_3$, $-CH_2CH_2CH_3$, $-CH(CH_3)_2$, $-CH_2CH(CH_3)_2$, $-CH_2OH$, $-CH_2OCH_3$, $-CH_2CH_2OH$, $-C(CH_3)_2OH$, $-CH(OH)CH(CH_3)_2$, $-C(CH_3)_2CH_2OH$, $-CH_2CH_2SO_2CH_3$, $-CH_2OP(O)(OH)_2$, $-CH_2F$, $-CHF_2$, $-CF_3$, $-CH_2CF_3$, $-CH_2CHF_2$, $-CH(CH_3)CN$, $-C(CH_3)_2CN$, $-CH_2CN$, $-CH_2NH_2$, $-CH_2NHSO_2CH_3$, $-CH_2NHCH_3$, $-CH_2N(CH_3)_2$, $-CO_2H$, $-COCH_3$, $-CO_2CH_3$, $-CO_2C(CH_3)_3$, $-COCH(OH)CH_3$, $-CONH_2$, $-CONHCH_3$, $-CON(CH_3)_2$, $-C(CH_3)_2CONH_2$, $-NH_2$, $-NHCH_3$, $-N(CH_3)_2$, $-NHCOCH_3$, $-N(CH_3)COCH_3$, $-NHS(O)_2CH_3$, $-N(CH_3)C(CH_3)_2CONH_2$, $-N(CH_3)CH_2CH_2S(O)_2CH_3$, $-NO_2$, =O, –OH, $-OCH_3$, $-OCH_2CH_3$, $-OCH_2CH_2OCH_3$, $-OCH_2CH_2OH$, $-OCH_2CH_2N(CH_3)_2$, $-O(CH_2CH_2O)_n-(CH_2)_mCO_2H$, $-O(CH_2CH_2O)_nH$, $-OP(O)(OH)_2$, $-S(O)_2N(CH_3)_2$, $-SCH_3$, $-S(O)_2CH_3$, and $-S(O)_3H$.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein R^1 is optionally substituted C_1-C_{20} heteroaryl.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein R^1 is pyrimidinyl or pyridinyl.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein X^2 and X^3 are each a bond, and R^2 and R^3 are independently selected from C_1-C_8 alkyl, –O–(C_1-C_{12} alkyl), –(C_1-C_{12} alkyldiyl)–OR^5, –(C_1-C_8

alkyldiyl)–N(R^5)CO_2R^5, –(C_1-C_{12} alkyl)–OC(O)N(R^5)$_2$, –O–(C_1-C_{12} alkyl)–N(R^5)CO_2R^5, and –O–(C_1-C_{12} alkyl)–OC(O)N(R^5)$_2$.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein X^2 is a bond, and R^2 is C_1-C_{12} alkyl.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein X^3 is O and R^3 is –(C_1-C_{12} alkyldiyl)–N(R^5)–*.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein R^3 is $–CH_2CH_2CH_2NH–$.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein L is –C(=O)–PEG–C(=O)–.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein AA_1 and AA_2 are independently selected from a side chain of a naturally-occurring amino acid.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein AA_1 or AA_2 with an adjacent nitrogen atom form a 5-membered ring proline amino acid.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein AA_1 and AA_2 are independently selected from H, $–CH_3$, $–CH(CH_3)_2$, $–CH_2(C_6H_5)$, $–CH_2CH_2CH_2CH_2NH_2$, $–CH_2CH_2CH_2NHC(NH)NH_2$, $–CHCH(CH_3)CH_3$, $–CH_2SO_3H$, and $–CH_2CH_2CH_2NHC(O)NH_2$.

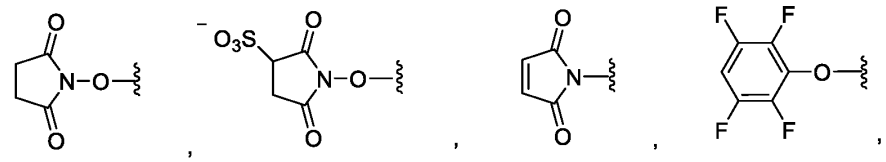
An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein AA_1 is $–CH(CH_3)_2$, and AA_2 is $–CH_2CH_2CH_2NHC(O)NH_2$.

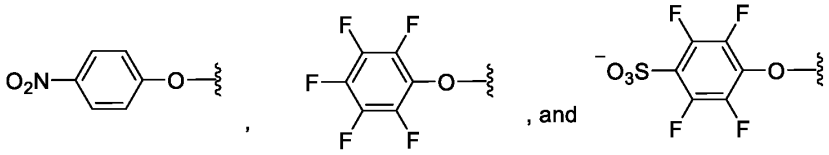
An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Y^1 is CR^1 and Y^2 is CH.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Y^1 is N and Y^2 is CH.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Y^1 is N and Y^2 is N.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Q is selected from:



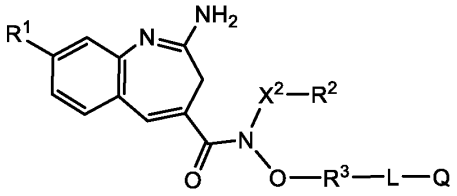


An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Q is phenoxy substituted with one or more F.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Q is 2,3,5,6-tetrafluorophenoxy.

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II includes wherein Q is 2,3,5,6-tetrafluoro, 4-sulfonate-phenoxy.

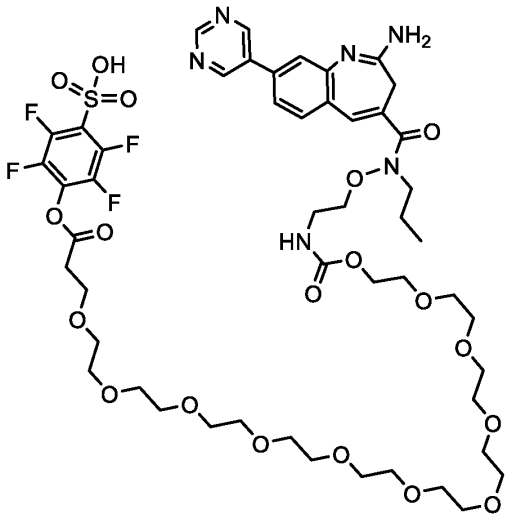
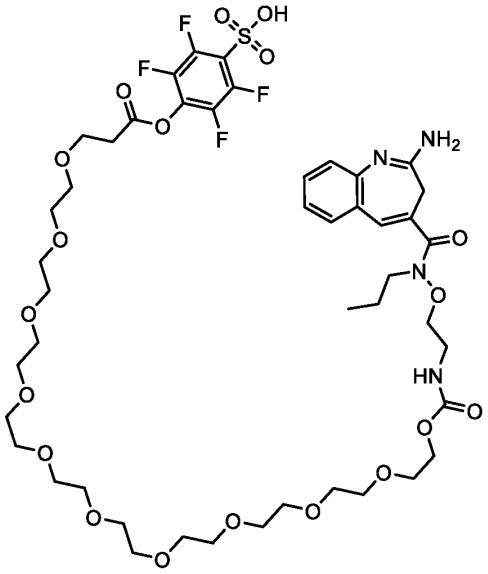
An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine-linker compound of Formula II has Formula IIa:

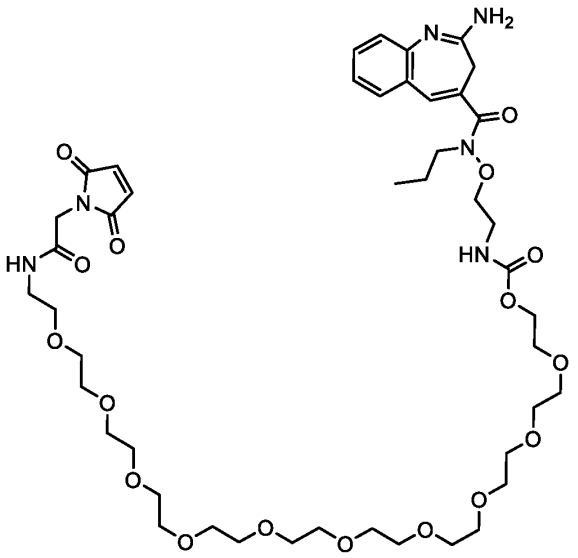
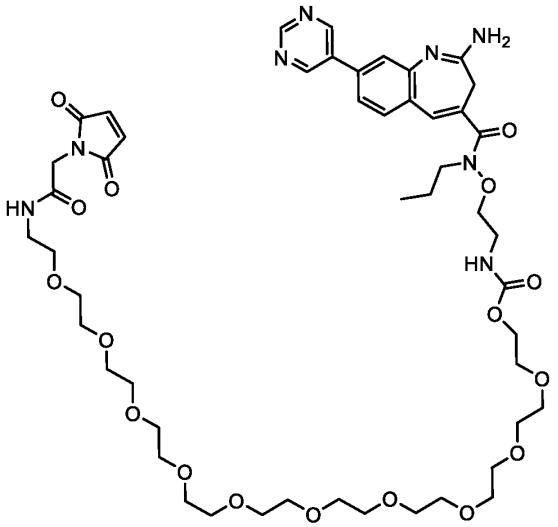


IIa

An exemplary embodiment of the 2-amino-4-carboxamide-benzazepine -linker compound is selected from Table 2. Each compound was characterized by mass spectrometry and shown to have the mass indicated.

Table 2a 2-amino-4-carboxamide-benzazepine-linker (2Am4CBza-L) Formula II compounds

2Am4CBza-L	Structure	MW
2Am4CBza-L-1		1165.2
2Am4CBza-L-2		1087.1

2Am4CBza-L-3		967.1
2Am4CBza-L-4		1045.1

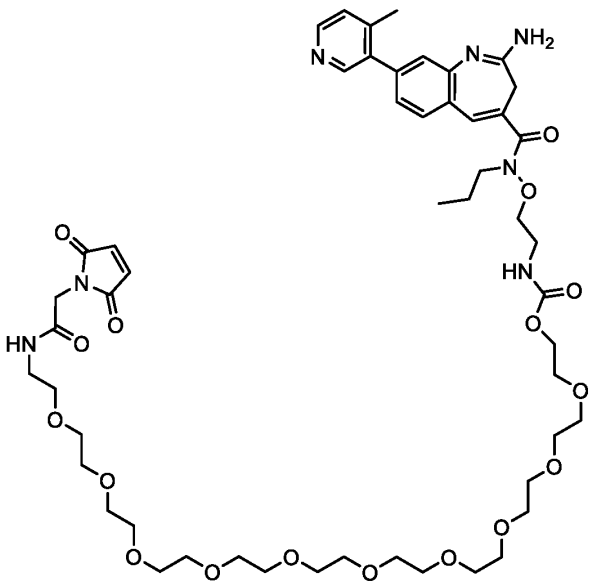
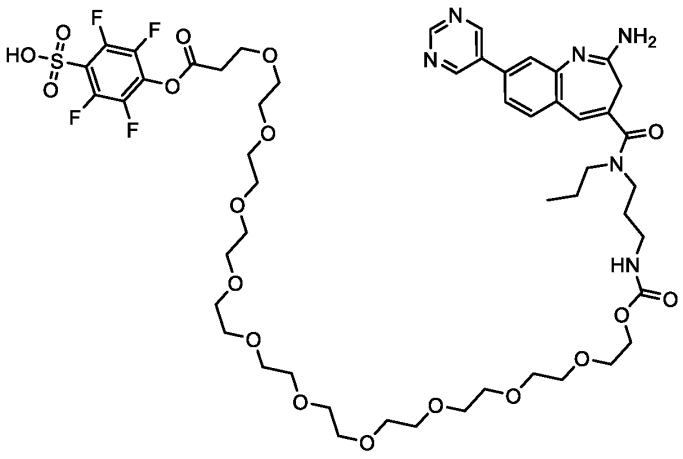
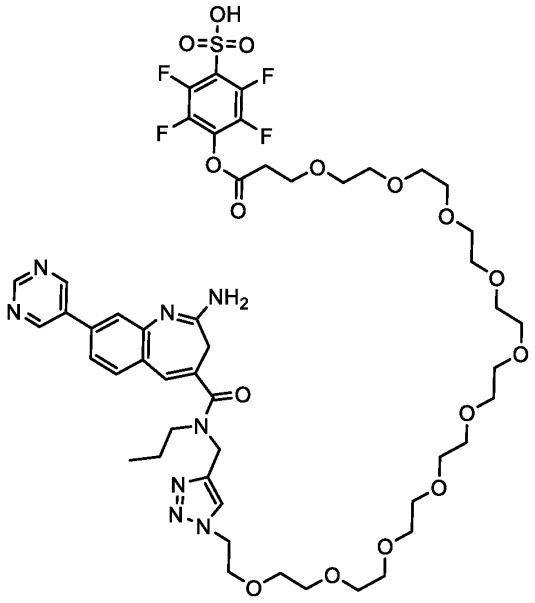
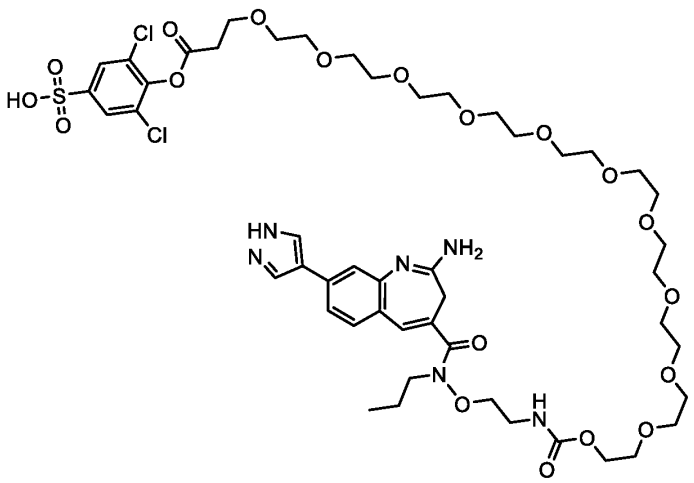
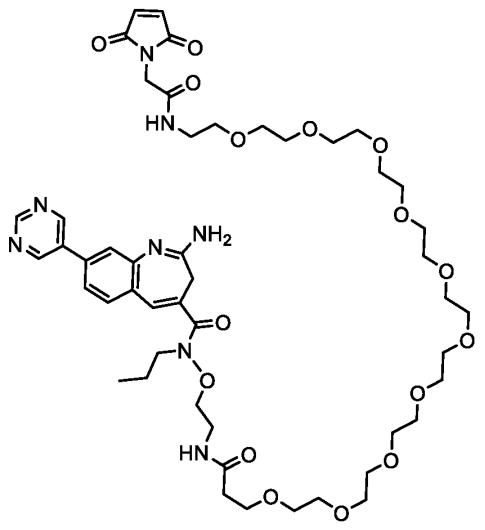
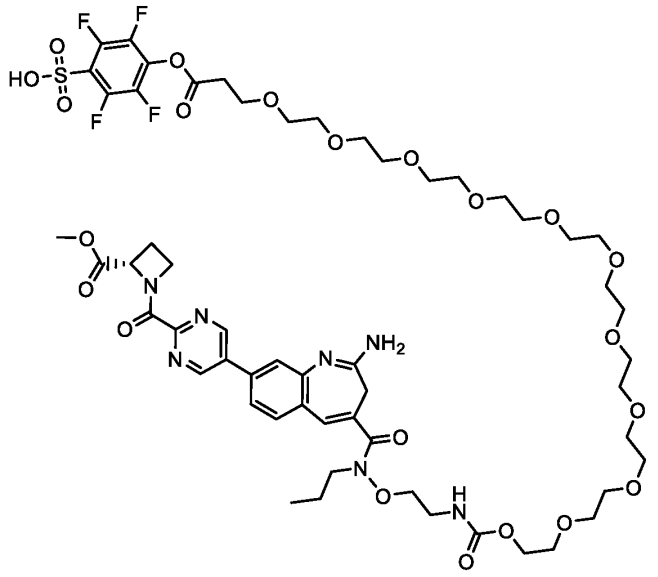
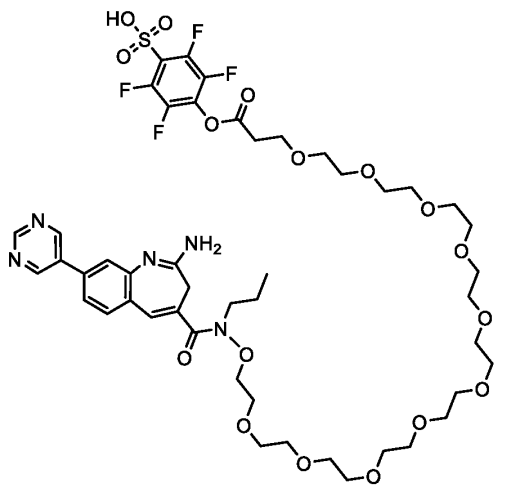
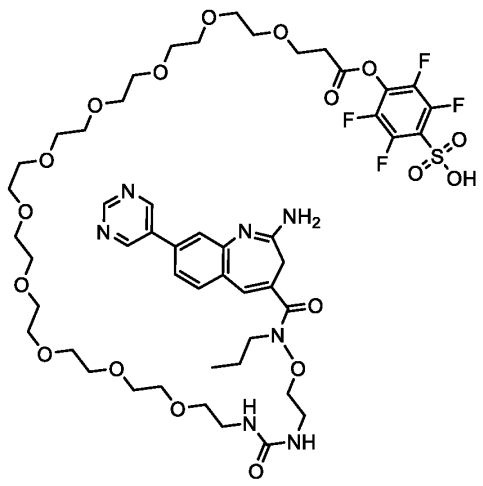
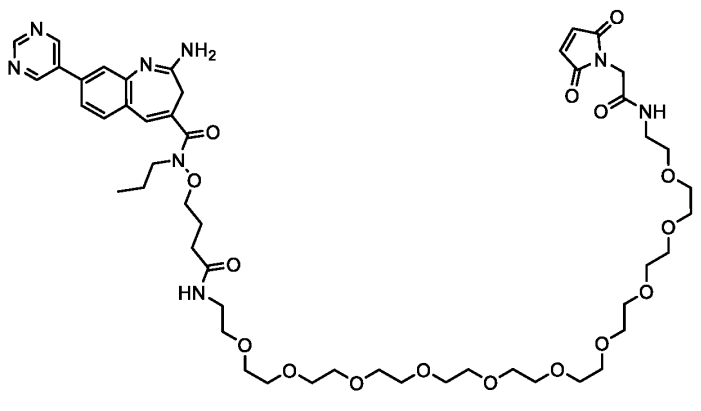
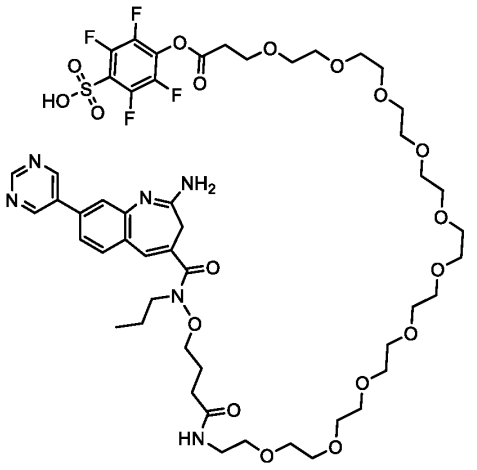
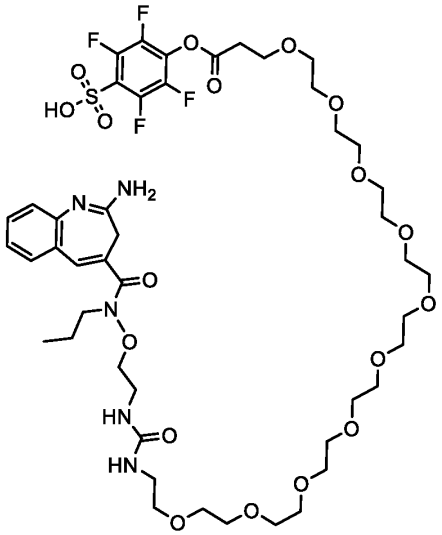
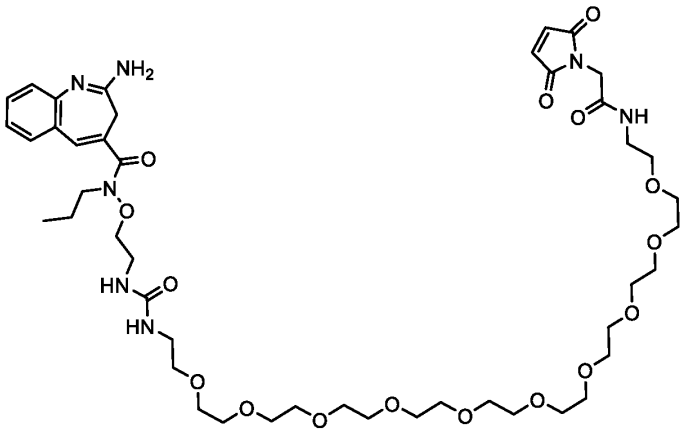
2Am4CBza-L-5		1058.2
2Am4CBza-L-6		1163.2

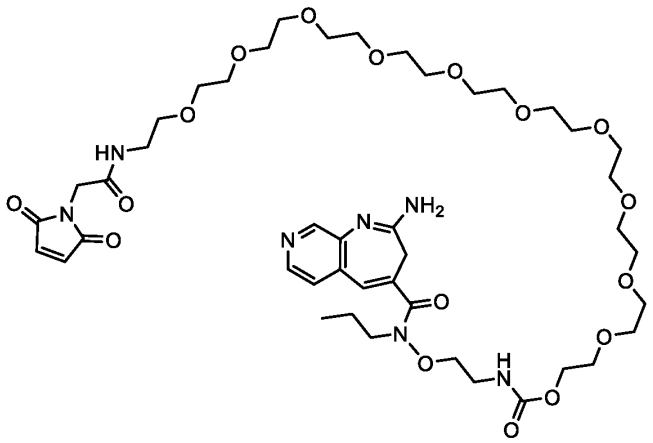
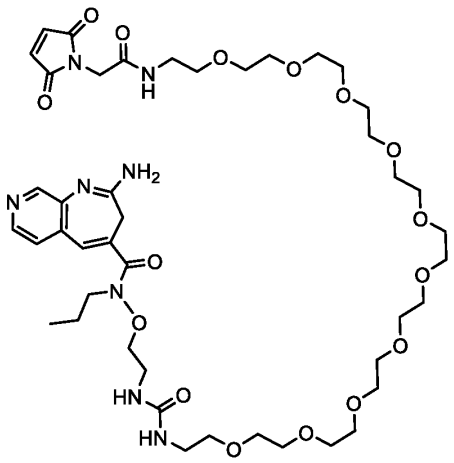
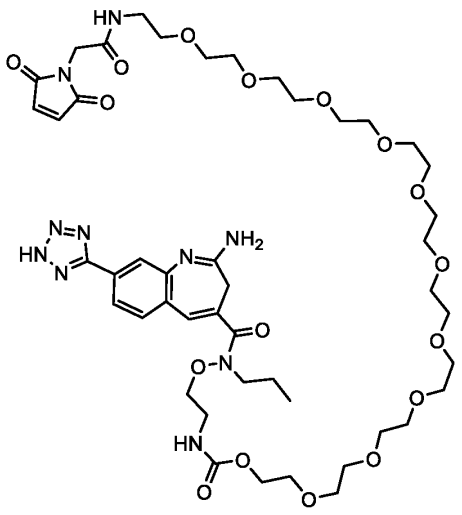
Table 2b 2-amino-4-carboxamide-benzazepine-linker (2Am4CBza-L) Formula II compounds

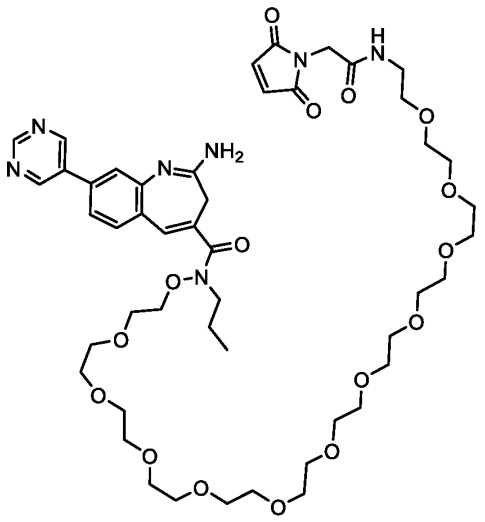
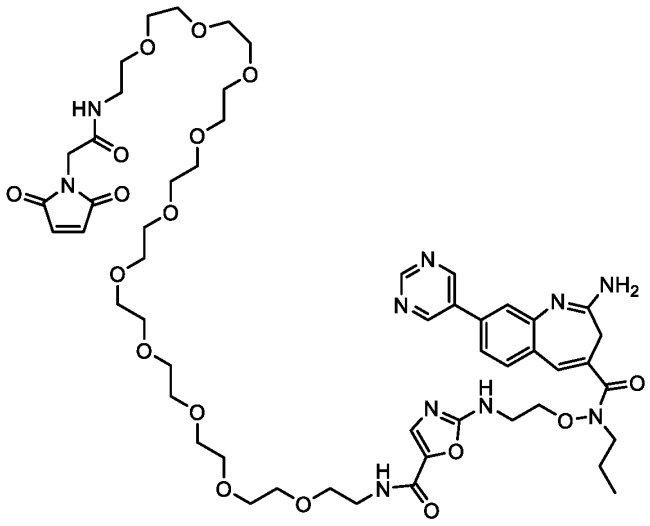
2Am4CBza-L	Structure	MW
2Am4CBza-L-7		1143.2
2Am4CBza-L-8		1150.1

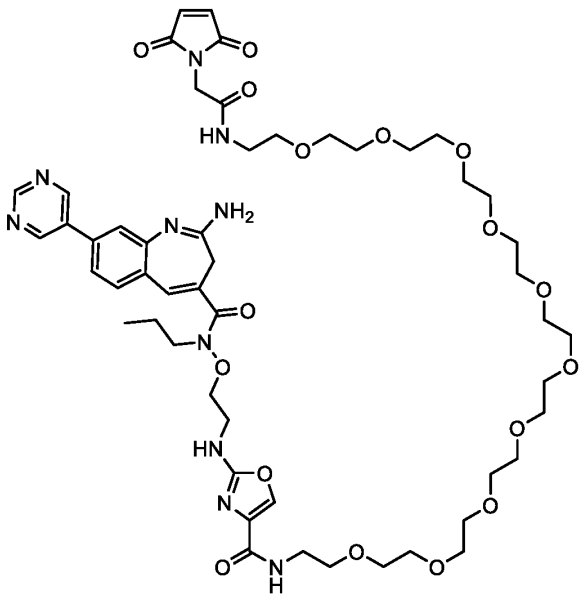
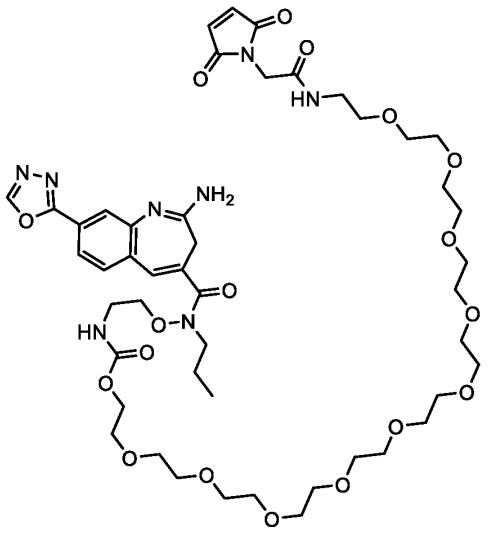
2Am4CBza-L-9		1029.1
2Am4CBza-L-10		1306.3

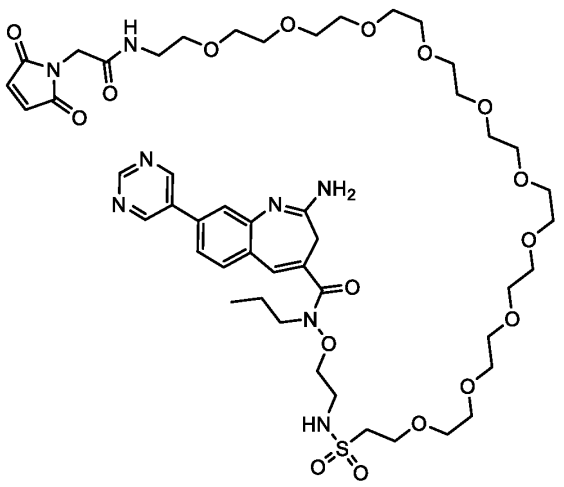
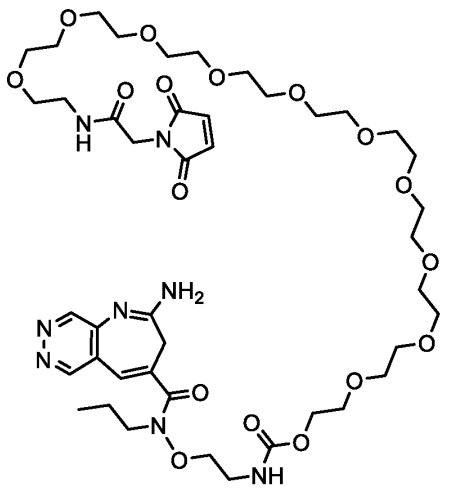
2Am4CBza-L-11		1078.1
2Am4CBza-L-12		1164.2
2Am4CBza-L-13		1043.2

2Am4CBza-L-14		1163.2
2Am4CBza-L-15		1086.1
2Am4CBza-L-16		966.1

2Am4CBza-L-17		968.1
2Am4CBza-L-18		967.1
2Am4CBza-L-19		1035.1

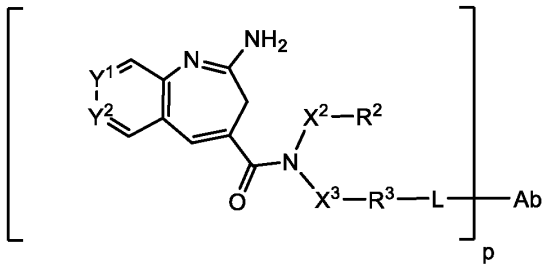
2Am4CBza-L-20		1002.1
2Am4CBza-L-21		1111.2

2Am4CBza-L-22		1111.2
2Am4CBza-L-23		1035.1

2Am4CBza-L-24		1065.2
2Am4CBza-L-25		969.1

IMMUNOCONJUGATES

Exemplary embodiments of immunoconjugates comprise an antibody covalently attached to one or more 2-amino-4-carboxamide-benzazepine (2Am4CBza) moieties by a linker, and having Formula I:



I

or a pharmaceutically acceptable salt thereof,

wherein:

Ab is the antibody which is an antibody construct or antigen binding domain that binds to a target selected from the group consisting of PD-L1, HER2, TROP2, or CEA;

p is an integer from 1 to 8;

X^2 and X^3 are independently selected from the group consisting of a bond, C(=O), C(=O)N(R^5), O, N(R^5), S, S(O)$_2$, and S(O)$_2$N(R^5);

Y^1 is CR^1 or N;

Y^2 is CH or N;

R^1 is selected from the group consisting of H, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^2 is selected from the group consisting of H, C_1-C_{12} alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^3 is selected from the group consisting of:

–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=O)*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=O)O–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–N(R^5)–S(O_2)–*;

–(C_1-C_{12} alkyldiyl)–OC(=O)–(C_2-C_9 heterocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–O–*;

–(C_1-C_{12} alkyldiyl)–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–NR^5–C(=NR^{5a})–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–*;

–(C_6-C_{20} aryldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_2-C_9 heterocyclyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–O–*; and

–(C_1-C_{20} heteroaryldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

where the asterisk * indicates the attachment site of the linker L;

R^5 is selected from the group consisting of H, C_6-C_{20} aryl and C_1-C_{12} alkyl, or two R^5 groups together form a 5- or 6-membered heterocyclyl ring;

R^{5a} is selected from the group consisting of C_6-C_{20} aryl and C_1-C_{20} heteroaryl;

L is selected from the group consisting of:

–C(=O)–PEG–C(=O)–;

–C(=O)–PEG–C(=O)–PEP–;

–C(=O)–PEG–N(R^5)–;

–C(=O)–PEG–N(R^5)–C(=O)–;

–C(=O)–PEG–NR^5–PEG–C(=O)–PEP–;

–C(=O)–PEG–N^+(R^5)$_2$–PEG–C(=O)–PEP–;

–C(=O)–PEG–NR^5CH(AA_1)C(=O)–PEG–C(=O)–PEP–;

–C(=O)–PEG–O–;

–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–OC(=O)–;

–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–C(=O)–;

–C(=O)–PEG–;

–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=O);

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–;

–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)–;

–C(=O)–PEG–C(=O)N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

–C(=O)–PEG–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

–succinimidyl–$(CH_2)_m$–C(=O)N(R^5)–PEG–C(=O)–;

–succinimidyl–$(CH_2)_m$–C(=O)N(R^5)–PEG–N(R^5)–;

–succinimidyl–$(CH_2)_m$–C(=O)N(R^5)–PEG–N(R^5)–C(=O)–;

–succinimidyl–$(CH_2)_m$–C(=O)N(R^5)–PEG–C(=O)–PEP–;

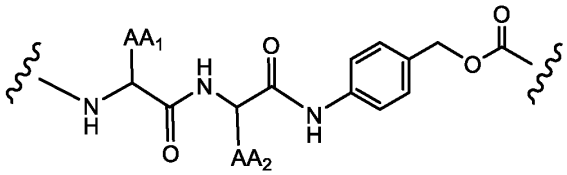
–succinimidyl–$(CH_2)_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)–;

–succinimidyl–$(CH_2)_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–; and

–succinimidyl–$(CH_2)_m$–C(=O)–PEP–N(R^5)–(C_1-C_{12} alkyldiyl)N(R^5)C(=O)–(C_2-C_5 monoheterocyclyldiyl)–;

PEG has the formula: $–(CH_2CH_2O)_n–(CH_2)_m–$ where m is an integer from 1 to 5, and n is an integer from 2 to 50;

PEP has the formula:



where AA_1 and AA_2 are independently selected from an amino acid side chain, or AA_1 or AA_2 and an adjacent nitrogen atom form a 5-membered ring proline amino acid, and the wavy line indicates a point of attachment; and

where alkyl, alkyldiyl, alkenyl, alkenyldiyl, alkynyl, alkynyldiyl, aryl, aryldiyl carbocyclyl, carbocyclyldiyl, heterocyclyl, heterocyclyldiyl, heteroaryl, and heteroaryldiyl are optionally substituted with one or more groups independently selected from F, Cl, Br, I, –CN, –CH_3, –CH_2CH_3, –CH=CH_2, –C≡CH, –C≡CCH_3, –$CH_2CH_2CH_3$, –$CH(CH_3)_2$, –$CH_2CH(CH_3)_2$, –CH_2OH, –CH_2OCH_3, –CH_2CH_2OH, –$C(CH_3)_2OH$, –$CH(OH)CH(CH_3)_2$, –$C(CH_3)_2CH_2OH$, –$CH_2CH_2SO_2CH_3$, –$CH_2OP(O)(OH)_2$, –CH_2F, –CHF_2, –CF_3, –CH_2CF_3, –CH_2CHF_2, –$CH(CH_3)CN$, –$C(CH_3)_2CN$, –CH_2CN, –CH_2NH_2, –$CH_2NHSO_2CH_3$, –CH_2NHCH_3, –$CH_2N(CH_3)_2$, –CO_2H, –$COCH_3$, –CO_2CH_3, –$CO_2C(CH_3)_3$, –$COCH(OH)CH_3$, –$CONH_2$, –$CONHCH_3$, –$CON(CH_3)_2$, –$C(CH_3)_2CONH_2$, –NH_2, –$NHCH_3$, –$N(CH_3)_2$, –$NHCOCH_3$, –$N(CH_3)COCH_3$, –$NHS(O)_2CH_3$, –$N(CH_3)C(CH_3)_2CONH_2$, –$N(CH_3)CH_2CH_2S(O)_2CH_3$, –$NO_2$, =O, –OH, –$OCH_3$, –$OCH_2CH_3$, –$OCH_2CH_2OCH_3$, –$OCH_2CH_2OH$, –$OCH_2CH_2N(CH_3)_2$, –$O(CH_2CH_2O)_n$–$(CH_2)_mCO_2H$, –$O(CH_2CH_2O)_nH$, –$OP(O)(OH)_2$, –$S(O)_2N(CH_3)_2$, –$SCH_3$, –$S(O)_2CH_3$, and –$S(O)_3H$.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is an antibody construct that has an antigen binding domain that binds PD-L1.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is selected from the group consisting of atezolizumab, durvalumab, and avelumab, or a biosimilar or a biobetter thereof.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is an antibody construct that has an antigen binding domain that binds HER2.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is selected from the group consisting of trastuzumab and pertuzumab, or a biosimilar or a biobetter thereof.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is an antibody construct that has an antigen binding domain that binds CEA.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is labetuzumab, or a biosimilar or a biobetter thereof.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the antibody is an antibody construct that has an antigen binding domain that binds TROP2.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein the Trop2 antibody is a monoclonal antibody.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein R^1 is optionally substituted C_1-C_{20} heteroaryl.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein R^1 is pyrimidinyl or pyridinyl.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein X^2 and X^3 are each a bond, and R^2 and R^3 are independently selected from C_1-C_8 alkyl, –O–(C_1-C_{12} alkyl), –(C_1-C_{12} alkyldiyl)–OR^5, –(C_1-C_8 alkyldiyl)–$N(R^5)CO_2R^5$, –(C_1-C_{12} alkyl)–$OC(O)N(R^5)_2$, –O–(C_1-C_{12} alkyl)–$N(R^5)CO_2R^5$, and –O–(C_1-C_{12} alkyl)–$OC(O)N(R^5)_2$.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein X^2 is a bond, and R^2 is C_1-C_{12} alkyl.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein X^3 is O and R^3 is –(C_1-C_{12} alkyldiyl)–$N(R^5)$–*.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein R^3 is $–CH_2CH_2CH_2NH–$.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein L is –C(=O)–PEG–C(=O)–.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein L comprises PEG and where n is 10 and m is 1.

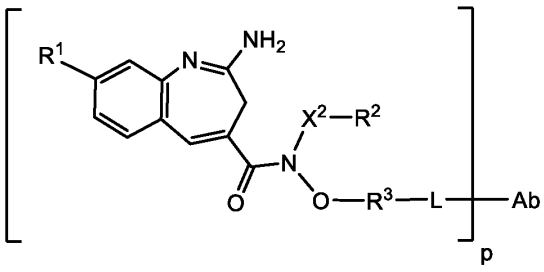
An exemplary embodiment of the immunoconjugate of Formula I includes wherein AA_1 and AA_2 are independently selected from a side chain of a naturally-occurring amino acid.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein AA_1 or AA_2 with an adjacent nitrogen atom form a 5-membered ring proline amino acid.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein AA_1 and AA_2 are independently selected from H, $–CH_3$, $–CH(CH_3)_2$, $–CH_2(C_6H_5)$, $–CH_2CH_2CH_2CH_2NH_2$, $–CH_2CH_2CH_2NHC(NH)NH_2$, $–CHCH(CH_3)CH_3$, $–CH_2SO_3H$, and $–CH_2CH_2CH_2NHC(O)NH_2$.

An exemplary embodiment of the immunoconjugate of Formula I includes wherein AA_1 is $–CH(CH_3)_2$, and AA_2 is $–CH_2CH_2CH_2NHC(O)NH_2$.

An exemplary embodiment of the immunoconjugate of Formula I is Formula Ia:



Ia.

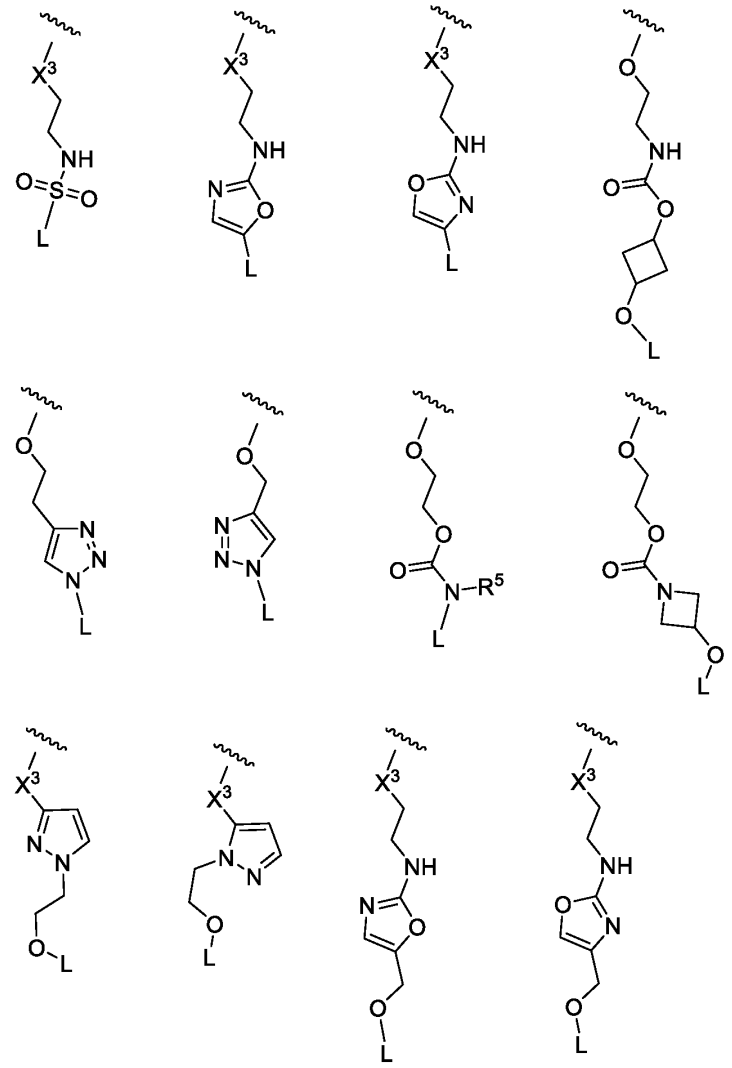
An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein R^1 is optionally substituted C_1-C_{20} heteroaryl.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein R^1 is pyrimidinyl or pyridyl.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein X^2 is a bond, and R^2 is C_1-C_{12} alkyl.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein R^3 is –(C_1-C_{12} alkyldiyl)–N(R^5)–*.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein X^3–R^3–L is selected from the group consisting of:



where the wavy line indicates the point of attachment to N.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein L comprises PEG and where n is 10 and m is 1.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein Y^1 is CR^1 and Y^2 is CH.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein Y^1 is N and Y^2 is CH.

An exemplary embodiment of the immunoconjugate of Formula Ia includes wherein Y^1 is N and Y^2 is N.

The invention includes all reasonable and operable combinations, and permutations of the features, of the Formula I embodiments.

In certain embodiments, the immunoconjugate compounds of the invention include those with immunostimulatory activity. The antibody-drug conjugates of the invention selectively deliver an effective dose of an 2-amino-4-carboxamide-benzazepine drug to tumor tissue, whereby greater selectivity (*i.e.,* a lower efficacious dose) may be achieved while increasing the therapeutic index ("therapeutic window") relative to unconjugated 2-amino-4-carboxamide-benzazepine.

Drug loading is represented by p, the number of 2Am4CBza moieties per antibody in an immunoconjugate of Formula I. Drug (2Am4CBza) loading may range from 1 to about 8 drug moieties (D) per antibody. Immunoconjugates of Formula I include mixtures or collections of antibodies conjugated with a range of drug moieties, from 1 to about 8. In some embodiments, the number of drug moieties that can be conjugated to an antibody is limited by the number of reactive or available amino acid side chain residues such as lysine and cysteine. In some embodiments, free cysteine residues are introduced into the antibody amino acid sequence by the methods described herein. In such aspects, p may be 1, 2, 3, 4, 5, 6, 7, or 8, and ranges thereof, such as from 1 to 8 or from 2 to 5. In any such aspect, p and n are equal (i.e., p = n = 1, 2, 3, 4, 5, 6, 7, or 8, or some range there between). Exemplary antibody-drug conjugates of Formula I include, but are not limited to, antibodies that have 1, 2, 3, or 4 engineered cysteine amino acids (Lyon, R. et al. (2012) *Methods in Enzym*. 502:123-138). In some embodiments, one or more free cysteine residues are already present in an antibody forming intrachain disulfide bonds, without the use of engineering, in which case the existing free cysteine residues may be used to conjugate the antibody to a drug. In some embodiments, an antibody is exposed to reducing conditions prior to conjugation of the antibody in order to generate one or more free cysteine residues.

For some immunoconjugates, p may be limited by the number of attachment sites on the antibody. For example, where the attachment is a cysteine thiol, as in certain exemplary

embodiments described herein, an antibody may have only one or a limited number of cysteine thiol groups, or may have only one or a limited number of sufficiently reactive thiol groups, to which the drug may be attached. In other embodiments, one or more lysine amino groups in the antibody may be available and reactive for conjugation with a 2Am4CBza-linker compound of Formula II. In certain embodiments, higher drug loading, *e.g.* p >5, may cause aggregation, insolubility, toxicity, or loss of cellular permeability of certain antibody-drug conjugates. In certain embodiments, the average drug loading for an immunoconjugate ranges from 1 to about 8; from about 2 to about 6; or from about 3 to about 5. In certain embodiments, an antibody is subjected to denaturing conditions to reveal reactive nucleophilic groups such as lysine or cysteine.

The loading (drug/antibody ratio) of an immunoconjugate may be controlled in different ways, and for example, by: (i) limiting the molar excess of the 2Am4CBza-linker intermediate compound relative to antibody, (ii) limiting the conjugation reaction time or temperature, and (iii) partial or limiting reductive denaturing conditions for optimized antibody reactivity.

It is to be understood that where more than one nucleophilic group of the antibody reacts with a drug, then the resulting product is a mixture of antibody-drug conjugate compounds with a distribution of one or more drug moieties attached to an antibody. The average number of drugs per antibody may be calculated from the mixture by a dual ELISA antibody assay, which is specific for antibody and specific for the drug. Individual immunoconjugate molecules may be identified in the mixture by mass spectroscopy and separated by HPLC, *e.g.* hydrophobic interaction chromatography (*see, e.g.*, McDonagh et al. (2006) Prot. Engr. Design & Selection 19(7):299-307; Hamblett et al. (2004) Clin. Cancer Res. 10:7063-7070; Hamblett, K.J., et al. "Effect of drug loading on the pharmacology, pharmacokinetics, and toxicity of an anti-CD30 antibody-drug conjugate," Abstract No. 624, American Association for Cancer Research, 2004 Annual Meeting, March 27-31, 2004, Proceedings of the AACR, Volume 45, March 2004; Alley, S.C., et al. "Controlling the location of drug attachment in antibody-drug conjugates," Abstract No. 627, American Association for Cancer Research, 2004 Annual Meeting, March 27-31, 2004, Proceedings of the AACR, Volume 45, March 2004). In certain embodiments, a homogeneous immunoconjugate with a single loading value may be isolated from the conjugation mixture by electrophoresis or chromatography.

An exemplary embodiment of the immunoconjugate of Formula **I** is selected from the Tables 3a and 3b Immunoconjugates. In a co-culture of cancer cells with a cDC-enriched primary cell isolate, certain immunoconjugates of Tables 3a and 3b induce secretion of cytokine IL-12p70 which is relevant to mounting an immune response to cancer. Immunoconjugates targeting *Clostridium difficile* toxin B with bezlotox (bezlotoxumab), IC 34-36, were studied as

isotype, non-tumor binding controls. Adjuvant conjugated to BSA protein, IC-24, also functions as a non-tumor binding control conjugate. Assessment of Immunoconjugate Activity *In Vitro* was conducted according to the methods of Example 203.

Table 3a Immunoconjugates (IC)

IC No.	2Am4CBza - linker Table 2a	Ab Antigen	DAR	cDC Activation (IL-12p70 Secretion) – EC_{50} (nM)
IC-1	2Am4CBzaL-1	CEA.9-G1fhL2 CEA	2.6	
IC-2	2Am4CBzaL-1	trastuzumab HER2	2.7	1.6

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Table 3b Immunoconjugates (IC)

IC No.	2Am4CBza - linker Tables 2a-b	Ab Antigen	DAR	cDC Activation (IL-12p70 Secretion) – EC_{50} (nM)
IC-3	2Am4CBzaL-6	trastuzumab HER2	2.3	
IC-4	2Am4CBzaL-3	trastuzumab HER2	4.1	1.5
IC-5	2Am4CBzaL-5	trastuzumab HER2	3.7	0.01
IC-6	2Am4CBzaL-4	trastuzumab HER2	4.1	1.1
IC-7	2Am4CBzaL-7	trastuzumab HER2	1.9	
IC-8	2Am4CBzaL-2	trastuzumab HER2	2.5	
IC-9	2Am4CBzaL-8	trastuzumab HER2	1.9	1.9

IC-10	2Am4CBzaL-10	TROP2.1-G1f TROP2	2.3	0.3
IC-11	2Am4CBzaL-1	TROP2.1-G1f TROP2	2.5	0.9
IC-12	2Am4CBzaL-9	TROP2.1-G1f TROP2	2.3	8.8
IC-13	2Am4CBzaL-4	PDL1.110-G1f PD-L1	3.7	
IC-14	2Am4CBzaL-4	avelumab PD-L1	4.2	
IC-15	2Am4CBzaL-8	TROP2.1-G1f TROP2	2.2	
IC-16	2Am4CBzaL-11	TROP2.1-G1f TROP2	2.3	
IC-17	2Am4CBzaL-12	TROP2.1-G1f TROP2	2.3	
IC-18	2Am4CBzaL-14	TROP2.1-G1f TROP2	3.3	
IC-19	2Am4CBzaL-15	TROP2.1-G1f TROP2	2.4	
IC-20	2Am4CBzaL-16	TROP2.1-G1f TROP2	4.2	3.2
IC-21	2Am4CBzaL-13	TROP2.1-G1f TROP2	4.3	0.9
IC-22	2Am4CBzaL-17	TROP2.1-G1f TROP2	3.8	0.7
IC-23	2Am4CBzaL-18	TROP2.1-G1f TROP2	4.2	1.4
IC-24	2Am4CBzaL-1	BSA monomer	3.2	
IC-25	2Am4CBzaL-19	TROP2.1-G1f TROP2	3.1	
IC-26	2Am4CBzaL-23	TROP2.1-G1f TROP2	2.2	

IC-27	2Am4CBzaL-24	TROP2.1-G1f TROP2	2.9	
IC-28	2Am4CBzaL-22	TROP2.1-G1f TROP2	3.1	
IC-29	2Am4CBzaL-21	TROP2.1-G1f TROP2	3.3	
IC-30	2Am4CBzaL-20	TROP2.1-G1f TROP2	2.8	
IC-31	2Am4CBzaL-17	PDL1.110-G1f PD-L1	3.1	0.7
IC-32	2Am4CBzaL-3	PDL1.110-G1f PD-L1	3.3	0.6
IC-33	2Am4CBzaL-25	PDL1.110-G1f PD-L1	4.0	
IC-34	2Am4CBzaL-3	bezlotox-G1f C. difficile	3.9	
IC-35	2Am4CBzaL-17	bezlotox-G1f C. difficile	3.5	
IC-36	2Am4CBzaL-25	bezlotox-G1f C. difficile	4.0	

PHARMACEUTICAL COMPOSITIONS OF IMMUNOCONJUGATES

The invention provides a composition, e.g., a pharmaceutically or pharmacologically acceptable composition or formulation, comprising a plurality of immunoconjugates as described herein and optionally a carrier therefor, e.g., a pharmaceutically or pharmacologically acceptable carrier. The immunoconjugates can be the same or different in the composition, i.e., the composition can comprise immunoconjugates that have the same number of adjuvants linked to the same positions on the antibody construct and/or immunoconjugates that have the same number of 2Am4CBza adjuvants linked to different positions on the antibody construct, that have different numbers of adjuvants linked to the same positions on the antibody construct, or that have different numbers of adjuvants linked to different positions on the antibody construct.

In an exemplary embodiment, a composition comprising the immunoconjugate compounds comprises a mixture of the immunoconjugate compounds, wherein the average drug

(2Am4CBza) loading per antibody in the mixture of immunoconjugate compounds is about 2 to about 5.

A composition of immunoconjugates of the invention can have an average adjuvant to antibody construct ratio of about 0.4 to about 10. A skilled artisan will recognize that the number of 2Am4CBza adjuvants conjugated to the antibody construct may vary from immunoconjugate to immunoconjugate in a composition comprising multiple immunoconjugates of the invention, and, thus, the adjuvant to antibody construct (e.g., antibody) ratio can be measured as an average, which may be referred to as the drug to antibody ratio (DAR). The adjuvant to antibody construct (e.g., antibody) ratio can be assessed by any suitable means, many of which are known in the art.

The average number of adjuvant moieties per antibody (DAR) in preparations of immunoconjugates from conjugation reactions may be characterized by conventional means such as mass spectrometry, ELISA assay, and HPLC. The quantitative distribution of immunoconjugates in a composition in terms of p may also be determined. In some instances, separation, purification, and characterization of homogeneous immunoconjugates where p is a certain value from immunoconjugates with other drug loadings may be achieved by means such as reverse phase HPLC or electrophoresis.

In some embodiments, the composition further comprises one or more pharmaceutically or pharmacologically acceptable excipients. For example, the immunoconjugates of the invention can be formulated for parenteral administration, such as IV administration or administration into a body cavity or lumen of an organ. Alternatively, the immunoconjugates can be injected intra-tumorally. Compositions for injection will commonly comprise a solution of the immunoconjugate dissolved in a pharmaceutically acceptable carrier. Among the acceptable vehicles and solvents that can be employed are water and an isotonic solution of one or more salts such as sodium chloride, e.g., Ringer's solution. In addition, sterile fixed oils can conventionally be employed as a solvent or suspending medium. For this purpose, any bland fixed oil can be employed, including synthetic monoglycerides or diglycerides. In addition, fatty acids such as oleic acid can likewise be used in the preparation of injectables. These compositions desirably are sterile and generally free of undesirable matter. These compositions can be sterilized by conventional, well known sterilization techniques. The compositions can contain pharmaceutically acceptable auxiliary substances as required to approximate physiological conditions such as pH adjusting and buffering agents, toxicity adjusting agents, e.g., sodium acetate, sodium chloride, potassium chloride, calcium chloride, sodium lactate and the like.

The composition can contain any suitable concentration of the immunoconjugate. The concentration of the immunoconjugate in the composition can vary widely, and will be selected primarily based on fluid volumes, viscosities, body weight, and the like, in accordance with the particular mode of administration selected and the patient's needs. In certain embodiments, the concentration of an immunoconjugate in a solution formulation for injection will range from about 0.1% (w/w) to about 10% (w/w).

METHOD OF TREATING CANCER WITH IMMUNOCONJUGATES

The invention provides a method for treating cancer. The method includes administering a therapeutically effective amount of an immunoconjugate as described herein (e.g., as a composition as described herein) to a subject in need thereof, e.g., a subject that has cancer and is in need of treatment for the cancer. The method includes administering a therapeutically effective amount of an immunoconjugate (IC) selected from Table 3.

It is contemplated that the immunoconjugate of the present invention may be used to treat various hyperproliferative diseases or disorders, e.g. characterized by the overexpression of a tumor antigen. Exemplary hyperproliferative disorders include benign or malignant solid tumors and hematological disorders such as leukemia and lymphoid malignancies.

In another aspect, an immunoconjugate for use as a medicament is provided. In certain embodiments, the invention provides an immunoconjugate for use in a method of treating an individual comprising administering to the individual an effective amount of the immunoconjugate. In one such embodiment, the method further comprises administering to the individual an effective amount of at least one additional therapeutic agent, *e.g.*, as described herein.

In a further aspect, the invention provides for the use of an immunoconjugate in the manufacture or preparation of a medicament. In one embodiment, the medicament is for treatment of cancer, the method comprising administering to an individual having cancer an effective amount of the medicament. In one such embodiment, the method further comprises administering to the individual an effective amount of at least one additional therapeutic agent, *e.g.*, as described herein.

Carcinomas are malignancies that originate in the epithelial tissues. Epithelial cells cover the external surface of the body, line the internal cavities, and form the lining of glandular tissues. Examples of carcinomas include, but are not limited to, adenocarcinoma (cancer that begins in glandular (secretory) cells such as cancers of the breast, pancreas, lung, prostate, stomach, gastroesophageal junction, and colon) adrenocortical carcinoma; hepatocellular carcinoma; renal cell carcinoma; ovarian carcinoma; carcinoma in situ; ductal carcinoma;

carcinoma of the breast; basal cell carcinoma; squamous cell carcinoma; transitional cell carcinoma; colon carcinoma; nasopharyngeal carcinoma; multilocular cystic renal cell carcinoma; oat cell carcinoma; large cell lung carcinoma; small cell lung carcinoma; non-small cell lung carcinoma; and the like. Carcinomas may be found in prostrate, pancreas, colon, brain (usually as secondary metastases), lung, breast, and skin. In some embodiments, methods for treating non-small cell lung carcinoma include administering an immunoconjugate containing an antibody construct that is capable of binding PD-L1 (e.g., atezolizumab, durvalumab, avelumab, biosimilars thereof, or biobetters thereof). In some embodiments, methods for treating breast cancer include administering an immunoconjugate containing an antibody construct that is capable of binding PD-L1 (e.g., atezolizumab, durvalumab, avelumab, biosimilars thereof, or biobetters thereof). In some embodiments, methods for treating triple-negative breast cancer include administering an immunoconjugate containing an antibody construct that is capable of binding PD-L1 (e.g., atezolizumab, durvalumab, avelumab, biosimilars thereof, or biobetters thereof).

Soft tissue tumors are a highly diverse group of rare tumors that are derived from connective tissue. Examples of soft tissue tumors include, but are not limited to, alveolar soft part sarcoma; angiomatoid fibrous histiocytoma; chondromyoxid fibroma; skeletal chondrosarcoma; extraskeletal myxoid chondrosarcoma; clear cell sarcoma; desmoplastic small round-cell tumor; dermatofibrosarcoma protuberans; endometrial stromal tumor; Ewing's sarcoma; fibromatosis (Desmoid); fibrosarcoma, infantile; gastrointestinal stromal tumor; bone giant cell tumor; tenosynovial giant cell tumor; inflammatory myofibroblastic tumor; uterine leiomyoma; leiomyosarcoma; lipoblastoma; typical lipoma; spindle cell or pleomorphic lipoma; atypical lipoma; chondroid lipoma; well-differentiated liposarcoma; myxoid/round cell liposarcoma; pleomorphic liposarcoma; myxoid malignant fibrous histiocytoma; high-grade malignant fibrous histiocytoma; myxofibrosarcoma; malignant peripheral nerve sheath tumor; mesothelioma; neuroblastoma; osteochondroma; osteosarcoma; primitive neuroectodermal tumor; alveolar rhabdomyosarcoma; embryonal rhabdomyosarcoma; benign or malignant schwannoma; synovial sarcoma; Evan's tumor; nodular fasciitis; desmoid-type fibromatosis; solitary fibrous tumor; dermatofibrosarcoma protuberans (DFSP); angiosarcoma; epithelioid hemangioendothelioma; tenosynovial giant cell tumor (TGCT); pigmented villonodular synovitis (PVNS); fibrous dysplasia; myxofibrosarcoma; fibrosarcoma; synovial sarcoma; malignant peripheral nerve sheath tumor; neurofibroma; pleomorphic adenoma of soft tissue; and neoplasias derived from fibroblasts, myofibroblasts, histiocytes, vascular cells/endothelial cells, and nerve sheath cells.

A sarcoma is a rare type of cancer that arises in cells of mesenchymal origin, e.g., in bone or in the soft tissues of the body, including cartilage, fat, muscle, blood vessels, fibrous tissue, or other connective or supportive tissue. Different types of sarcoma are based on where the cancer forms. For example, osteosarcoma forms in bone, liposarcoma forms in fat, and rhabdomyosarcoma forms in muscle. Examples of sarcomas include, but are not limited to, askin's tumor; sarcoma botryoides; chondrosarcoma; ewing's sarcoma; malignant hemangioendothelioma; malignant schwannoma; osteosarcoma; and soft tissue sarcomas (e.g., alveolar soft part sarcoma; angiosarcoma; cystosarcoma phyllodesdermatofibrosarcoma protuberans (DFSP); desmoid tumor; desmoplastic small round cell tumor; epithelioid sarcoma; extraskeletal chondrosarcoma; extraskeletal osteosarcoma; fibrosarcoma; gastrointestinal stromal tumor (GIST); hemangiopericytoma; hemangiosarcoma (more commonly referred to as "angiosarcoma"); kaposi's sarcoma; leiomyosarcoma; liposarcoma; lymphangiosarcoma; malignant peripheral nerve sheath tumor (MPNST); neurofibrosarcoma; synovial sarcoma; and undifferentiated pleomorphic sarcoma).

A teratoma is a type of germ cell tumor that may contain several different types of tissue (e.g., can include tissues derived from any and/or all of the three germ layers: endoderm, mesoderm, and ectoderm), including, for example, hair, muscle, and bone. Teratomas occur most often in the ovaries in women, the testicles in men, and the tailbone in children.

Melanoma is a form of cancer that begins in melanocytes (cells that make the pigment melanin). Melanoma may begin in a mole (skin melanoma), but can also begin in other pigmented tissues, such as in the eye or in the intestines.

Merkel cell carcinoma is a rare type of skin cancer that usually appears as a flesh-colored or bluish-red nodule on the face, head or neck. Merkel cell carcinoma is also called neuroendocrine carcinoma of the skin. In some embodiments, methods for treating Merkel cell carcinoma include administering an immunoconjugate containing an antibody construct that is capable of binding PD-L1 (e.g., atezolizumab, durvalumab, avelumab, biosimilars thereof, or biobetters thereof). In some embodiments, the Merkel cell carcinoma has metastasized when administration occurs.

Leukemias are cancers that start in blood-forming tissue, such as the bone marrow, and cause large numbers of abnormal blood cells to be produced and enter the bloodstream. For example, leukemias can originate in bone marrow-derived cells that normally mature in the bloodstream. Leukemias are named for how quickly the disease develops and progresses (e.g., acute versus chronic) and for the type of white blood cell that is affected (e.g., myeloid versus lymphoid). Myeloid leukemias are also called myelogenous or myeloblastic leukemias. Lymphoid leukemias are also called lymphoblastic or lymphocytic leukemia. Lymphoid

leukemia cells may collect in the lymph nodes, which can become swollen. Examples of leukemias include, but are not limited to, Acute myeloid leukemia (AML), Acute lymphoblastic leukemia (ALL), Chronic myeloid leukemia (CML), and Chronic lymphocytic leukemia (CLL).

Lymphomas are cancers that begin in cells of the immune system. For example, lymphomas can originate in bone marrow-derived cells that normally mature in the lymphatic system. There are two basic categories of lymphomas. One category of lymphoma is Hodgkin lymphoma (HL), which is marked by the presence of a type of cell called the Reed-Sternberg cell. There are currently 6 recognized types of HL. Examples of Hodgkin lymphomas include nodular sclerosis classical Hodgkin lymphoma (CHL), mixed cellularity CHL, lymphocyte-depletion CHL, lymphocyte-rich CHL, and nodular lymphocyte predominant HL.

The other category of lymphoma is non-Hodgkin lymphomas (NHL), which includes a large, diverse group of cancers of immune system cells. Non-Hodgkin lymphomas can be further divided into cancers that have an indolent (slow-growing) course and those that have an aggressive (fast-growing) course. There are currently 61 recognized types of NHL. Examples of non-Hodgkin lymphomas include, but are not limited to, AIDS-related Lymphomas, anaplastic large-cell lymphoma, angioimmunoblastic lymphoma, blastic NK-cell lymphoma, Burkitt's lymphoma, Burkitt-like lymphoma (small non-cleaved cell lymphoma), chronic lymphocytic leukemia/small lymphocytic lymphoma, cutaneous T-Cell lymphoma, diffuse large B-Cell lymphoma, enteropathy-type T-Cell lymphoma, follicular lymphoma, hepatosplenic gamma-delta T-Cell lymphomas, T-Cell leukemias, lymphoblastic lymphoma, mantle cell lymphoma, marginal zone lymphoma, nasal T-Cell lymphoma, pediatric lymphoma, peripheral T-Cell lymphomas, primary central nervous system lymphoma, transformed lymphomas, treatment-related T-Cell lymphomas, and Waldenstrom's macroglobulinemia.

Brain cancers include any cancer of the brain tissues. Examples of brain cancers include, but are not limited to, gliomas (e.g., glioblastomas, astrocytomas, oligodendrogliomas, ependymomas, and the like), meningiomas, pituitary adenomas, and vestibular schwannomas, primitive neuroectodermal tumors (medulloblastomas).

Immunoconjugates of the invention can be used either alone or in combination with other agents in a therapy. For instance, an immunoconjugate may be co-administered with at least one additional therapeutic agent, such as a chemotherapeutic agent. Such combination therapies encompass combined administration (where two or more therapeutic agents are included in the same or separate formulations), and separate administration, in which case, administration of the immunoconjugate can occur prior to, simultaneously, and/or following, administration of the additional therapeutic agent and/or adjuvant. Immunoconjugates can also be used in combination with radiation therapy.

The immunoconjugates of the invention (and any additional therapeutic agent) can be administered by any suitable means, including parenteral, intrapulmonary, and intranasal, and, if desired for local treatment, intralesional administration. Parenteral infusions include intramuscular, intravenous, intraarterial, intraperitoneal, or subcutaneous administration. Dosing can be by any suitable route, *e.g.* by injections, such as intravenous or subcutaneous injections, depending in part on whether the administration is brief or chronic. Various dosing schedules including but not limited to single or multiple administrations over various time-points, bolus administration, and pulse infusion are contemplated herein.

Atezolizumab, durvalumab, avelumab, biosimilars thereof, and biobetters thereof are known to be useful in the treatment of cancer, particularly breast cancer, especially triple negative (test negative for estrogen receptors, progesterone receptors, and excess HER2 protein) breast cancer, bladder cancer, and Merkel cell carcinoma. The immunoconjugate described herein can be used to treat the same types of cancers as atezolizumab, durvalumab, avelumab, biosimilars thereof, and biobetters thereof, particularly breast cancer, especially triple negative (test negative for estrogen receptors, progesterone receptors, and excess HER2 protein) breast cancer, bladder cancer, and Merkel cell carcinoma.

The immunoconjugate is administered to a subject in need thereof in any therapeutically effective amount using any suitable dosing regimen, such as the dosing regimens utilized for atezolizumab, durvalumab, avelumab, biosimilars thereof, and biobetters thereof. For example, the methods can include administering the immunoconjugate to provide a dose of from about 100 ng/kg to about 50 mg/kg to the subject. The immunoconjugate dose can range from about 5 mg/kg to about 50 mg/kg, from about 10 μg/kg to about 5 mg/kg, or from about 100 μg/kg to about 1 mg/kg. The immunoconjugate dose can be about 100, 200, 300, 400, or 500 μg/kg. The immunoconjugate dose can be about 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 mg/kg. The immunoconjugate dose can also be outside of these ranges, depending on the particular conjugate as well as the type and severity of the cancer being treated. Frequency of administration can range from a single dose to multiple doses per week, or more frequently. In some embodiments, the immunoconjugate is administered from about once per month to about five times per week. In some embodiments, the immunoconjugate is administered once per week.

In another aspect, the invention provides a method for preventing cancer. The method comprises administering a therapeutically effective amount of an immunoconjugate (e.g., as a composition as described above) to a subject. In certain embodiments, the subject is susceptible to a certain cancer to be prevented. For example, the methods can include administering the immunoconjugate to provide a dose of from about 100 ng/kg to about 50 mg/kg to the subject. The immunoconjugate dose can range from about 5 mg/kg to about 50 mg/kg, from about 10

μg/kg to about 5 mg/kg, or from about 100 μg/kg to about 1 mg/kg. The immunoconjugate dose can be about 100, 200, 300, 400, or 500 μg/kg. The immunoconjugate dose can be about 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 mg/kg. The immunoconjugate dose can also be outside of these ranges, depending on the particular conjugate as well as the type and severity of the cancer being treated. Frequency of administration can range from a single dose to multiple doses per week, or more frequently. In some embodiments, the immunoconjugate is administered from about once per month to about five times per week. In some embodiments, the immunoconjugate is administered once per week.

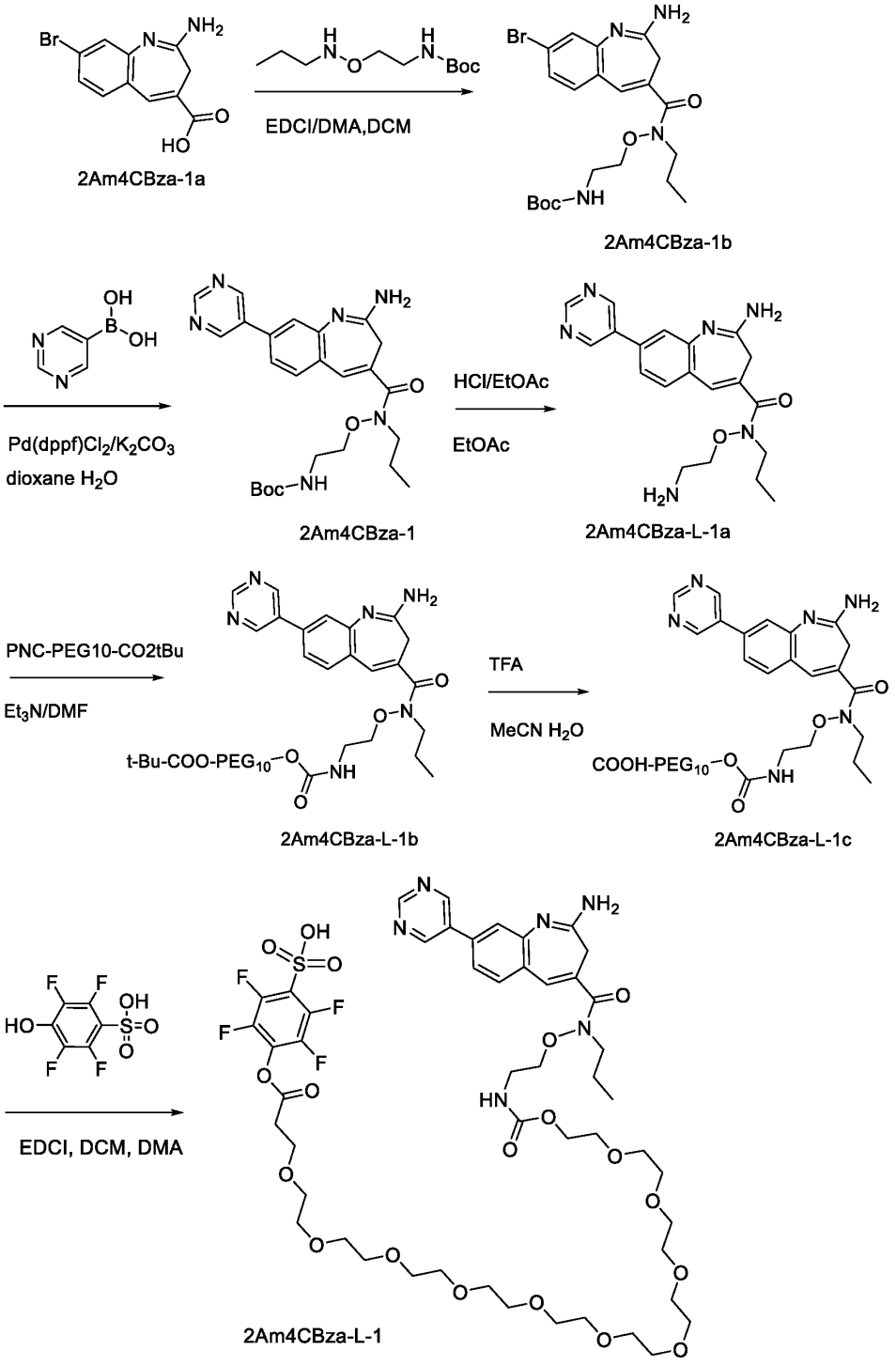
Some embodiments of the invention provide methods for treating cancer as described above, wherein the cancer is breast cancer. Breast cancer can originate from different areas in the breast, and a number of different types of breast cancer have been characterized. For example, the immunoconjugates of the invention can be used for treating ductal carcinoma *in situ;* invasive ductal carcinoma (*e.g.,* tubular carcinoma; medullary carcinoma; mucinous carcinoma; papillary carcinoma; or cribriform carcinoma of the breast); lobular carcinoma *in situ*; invasive lobular carcinoma; inflammatory breast cancer; and other forms of breast cancer such as triple negative (test negative for estrogen receptors, progesterone receptors, and excess HER2 protein) breast cancer. In some embodiments, methods for treating breast cancer include administering an immunoconjugate containing an antibody construct that is capable of binding HER2 (e.g. trastuzumab, pertuzumab, biosimilars, or biobetters thereof) and PD-L1 (e.g., atezolizumab, durvalumab, avelumab, biosimilars, or biobetters thereof). In some embodiments, methods for treating colon cancer lung cancer, renal cancer, pancreatic cancer, gastric cancer, and esophageal cancer include administering an immunoconjugate containing an antibody construct that is capable of binding CEA, or tumors over-expressing CEA (e.g. labetuzumab, biosimilars, or biobetters thereof).

In some embodiments, the cancer is susceptible to a pro-inflammatory response induced by TLR7 and/or TLR8.

EXAMPLES

Preparation of 2-amino-4-carboxamide-benzazepine compounds (2Am4CBza) and intermediates

Example 1 Synthesis of 4-[3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[(2-amino-8-pyrimidin-5-yl-3H-1-benzazepine-4-carbonyl)-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoyloxy]-2,3,5,6-tetrafluoro-benzenesulfonic acid, 2Am4CBza-L-1



Preparation of tert-butyl N-[2-[(2-amino-8-bromo-3H-1-benzazepine-4-carbonyl) -propyl-amino]oxyethyl]carbamate, 2Am4CBza-1b

To a solution of 2-amino-8-bromo-3H-1-benzazepine-4-carboxylic acid, 2Am4CBza-1a (300 mg, 1.07 mmol, 1.0 eq) and tert-butyl N-[2-(propylaminooxy)ethyl]carbamate (256 mg, 1.17 mmol, 1.1 eq) in DCM (3 mL) and DMA (2 mL) was added 1-ethyl-3-(3-

dimethylaminopropyl)carbodiimide hydrochloride, EDC, EDCI (818 mg, 4.27 mmol, 4.0 eq)., and then stirred at 20 °C for 1 hr. The mixture was concentrated under reduced pressure at 40 °C to remove DCM. The residue was poured into ice-water (w/w = 1/1) (10 mL) and stirred for 10 min. The aqueous phase was extracted with ethyl acetate (20 mL x 3). The combined organic phase was washed with brine (10 mL x 2), dried with anhydrous Na_2SO_4, filtered and concentrated in vacuum. The residue was purified by silica gel chromatography (column height: 250 mm, diameter: 100 mm, 100-200 mesh silica gel, Petroleum ether/Ethyl acetate=1/0, 0/1, Ethyl acetate/Methanol=1/0,3/1) to afford 2Am4CBza-1b (230 mg, 478 umol, 44.8% yield) as yellow solid. ^{1}H NMR (MeOD, 400MHz)δ 7.63-7.54 (m, 3H), 7.44 (s, 1H), 3.94 (t, J = 5.2 Hz, 2H), 3.76 (t, J = 7.2 Hz, 2H), 3.40 (s, 2H), 3.27 (t, J = 5.6 Hz, 2H), 1.78 (sxt, J = 7.6 Hz, 2H), 1.37 (s, 9H), 1.00 (t, J = 7.6 Hz, 3H).

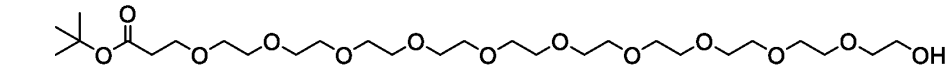
Preparation of tert-butyl N-[2-[(2-amino-8-pyrimidin-5-yl-3H-1-benzazepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-1

A mixture of 2Am4CBza-1b (200 mg, 415 umol, 1.0 eq), pyrimidin-5-ylboronic acid (154 mg, 1.25 mmol, 3.0 eq), K_2CO_3 (115 mg, 831 umol, 2.0 eq) and $Pd(dppf)Cl_2$ (91.2 mg, 125 umol, 0.3 eq) in dioxane (3.5 mL) and H_2O (1 mL) was degassed and purged with N_2 for 3 times, and then stirred at 100°C for 2 hrs under N_2 atmosphere. The mixture was concentrated under reduced pressure at 40°C. The residue was diluted with water (10 mL) and stirred for 5 min. The aqueous phase was extracted with ethyl acetate (20 mL x 3). The combined organic phase was washed with brine (10 mL), dried with anhydrous Na_2SO_4, filtered and concentrated in vacuum. The mixture was purified by prep-HPLC(column: Phenomenex Luna 80*30mm*3um;mobile phase: [water(0.1%TFA)-ACN];B%: 20%-50%,8min) to afford 2Am4CBza-1 (20 mg, 33.6 umol, 8.10% yield, TFA) as white solid. ^{1}H NMR (MeOD, 400MHz)δ 9.23 (s, 1H), 9.15 (s, 2H), 7.85-7.78 (m, 2H), 7.74 (s, 1H), 7.53 (s, 1H), 3.96 (t, J = 5.2 Hz, 2H), 3.77 (t, J = 7.2 Hz, 2H), 3.44 (s, 2H), 3.30-3.25 (m, 2H), 1.79 (sxt, J = 7.2 Hz, 2H), 1.36 (s, 9H), 1.01 (t, J = 7.6Hz, 3H). LC/MS [M+H] 481.2 (calculated); LC/MS [M+H] 481.2 (observed).

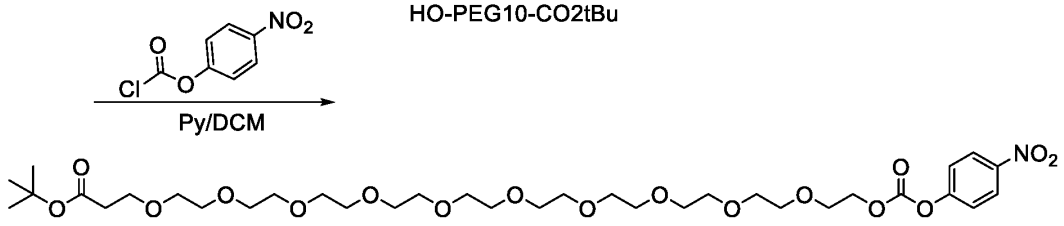
Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-8-pyrimidin-5-yl-3H- 1-benzazepine-4-carboxamide, 2Am4CBza-L-1a

To a solution of 2Am4CBza-1 (250 mg, 520 umol, 1.0 eq) in EtOAc (5 mL) was added HCl/EtOAc (4 M, 5.0 mL, 38.4 eq), and then stirred at 20°C for 1 hr. The mixture was concentrated in vacuum. The crude product 2Am4CBza-L-1a (340 mg, crude, 2HCl) was used into the next step without further purification as yellow solid.

Preparation of tert-butyl 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-(4-nitrophenoxy)carbonyl oxyethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoate, PNC-PEG10-CO2tBu



HO-PEG10-CO2tBu



PNC-PEG10-CO2tBu

To a mixture of tert-butyl 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-(2-hydroxyethoxy)ethoxy]ethoxy] ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoate, HO-PEG10-CO2tBu (1 g, 1.70 mmol, 1.0 eq) and (4-nitrophenyl)carbonochloridate (378 mg, 1.87 mmol, 1.1 eq) in DCM (20 mL) was added pyridine (202 mg, 2.56 mmol, 206 uL, 1.5 eq) at 0 °C. The mixture was stirred at 25 °C for 2 hrs. The pH of the mixture was adjusted to about 4 with 1M HCl. The residue was poured into ice-water (w/w = 1/1) (100 mL) and stirred for 10 min. The aqueous phase was extracted with DCM (50 mL x 3). The combined organic phase was dried with anhydrous Na_2SO_4, filtered and concentrated in vacuum. The residue was purified by silica gel chromatography (column height: 250 mm, diameter: 100 mm, 100-200 mesh silica gel, Petroleum ether/Ethyl acetate=1/0:0/1, Ethyl acetate/Methanol=1/0:2/1) to afford PNC-PEG10-CO2tBu (650 mg, 865 umol, 50.73% yield) as colorless oil. ^{1}H NMR (MeOD,400MHz)δ 8.38-8.27 (m, 2H), 7.54-7.45 (m, 2H), 4.47-4.42 (m, 2H), 3.80-3.53 (m, 40H), 2.53-2.44 (m, 2H), 1.50-1.41 (m, 9H).

Preparation of tert-butyl 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[(2-amino-8-pyrimidin-5-yl-3H-1-benzazepine-4-carbonyl)-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoate, 2Am4CBza-L-1b

To a solution of 2Am4CBza-L-1a (130 mg, 287 umol, 1.0 eq, 2HCl) and Et_3N (87.1 mg, 860 umol, 120 uL, 3.0 eq) in DMF (2 mL) was added PNC-PEG10-CO2tBu (237 mg, 315 umol, 1.1 eq) at 0°C, and then stirred at 20°C for 1 hr. The mixture was filtered and purified by prep-HPLC(column: Phenomenex Luna 80*30mm*3um;mobile phase: [water(0.1%TFA)-ACN];B%: 15%-45%,8min) to afford 2Am4CBza-L-1b (300 mg, 271 umol, 94.5% yield, TFA) as white solid.

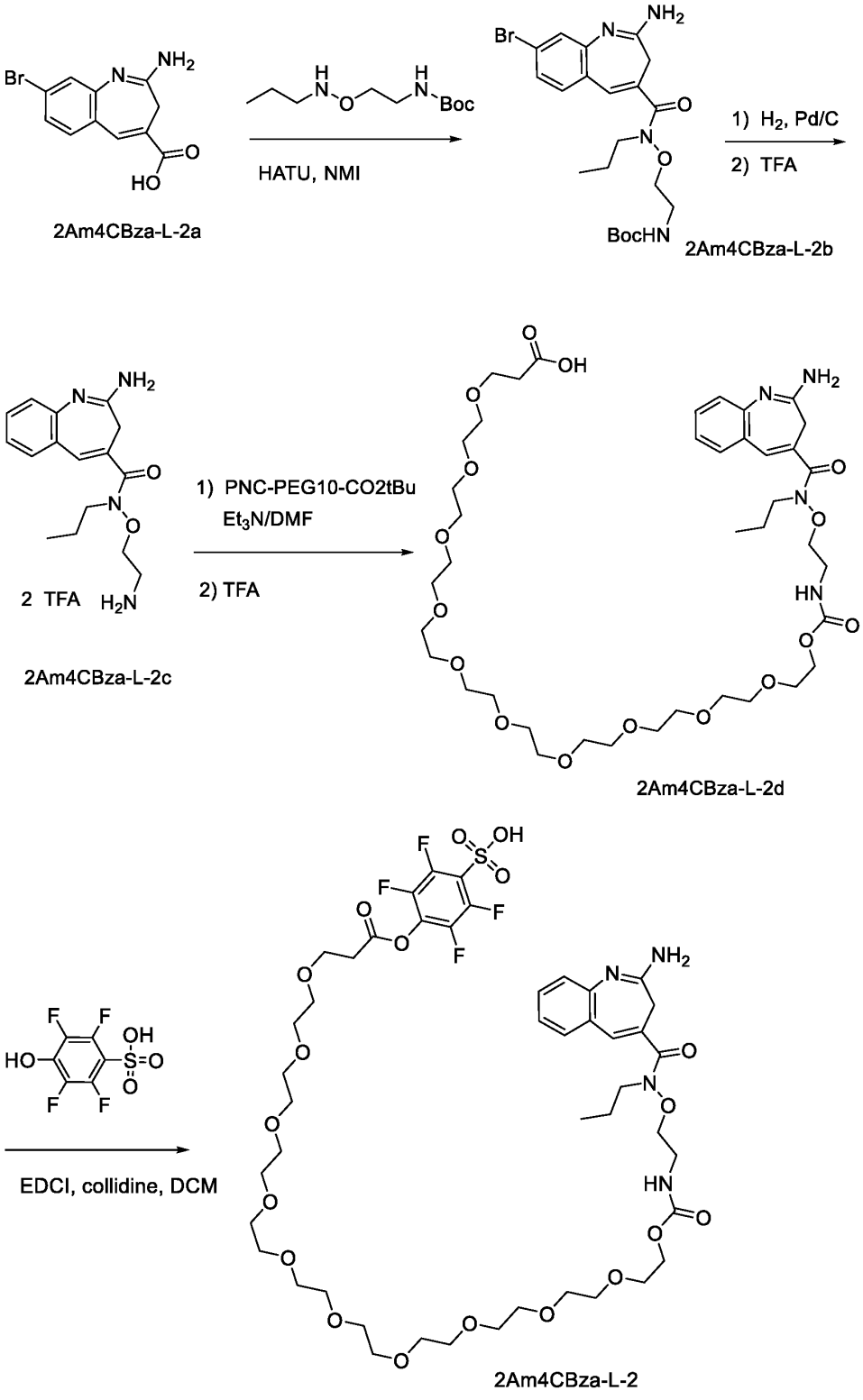
Preparation of 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[(2-amino-8-pyrimidin-5-yl-3H- 1-benzazepine-4-carbonyl)-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoic acid, 2Am4CBza-L-1c

To a solution of 2Am4CBza-L-1b (300 mg, 271 umol, 1.0 eq, TFA) in MeCN (1 mL) and H_2O (2 mL) was added TFA (247 mg, 2.17 mmol, 161 uL, 8.0 eq), and then stirred at 80 °C for 1 hr. The mixture was concentrated in vacuum, the residue was diluted with water (10mL) and the pH of mixture was adjusted to ~6 with aq $NaHCO_3$, the aqueous phase was extracted with ethyl acetate (10 mL x 1)-discarded. The aqueous phase was further extracted with DCM/i-PrOH (10 mL x 3). The combined organic phase (DCM/i-PrOH) was concentrated in vacuum to afford 2Am4CBza-L-1c (170 mg, 162 umol, 59.7% yield, TFA) as yellow oil. ^{1}H NMR (MeOD, 400MHz)δ 9.22 (s, 1H), 9.15 (s, 2H), 7.90-7.73 (m, 3H), 7.47 (s, 1H), 3.99 (t, J = 5.2 Hz, 2H), 3.85-3.69 (m, 4H), 3.68-3.53 (m, 38H), 3.49-3.42 (m, 4H), 2.54 (q, J = 6.4 Hz, 2H), 1.85-1.72 (m, 2H), 1.01 (t, J = 7.6 Hz, 3H).

Preparation of 2Am4CBza-L-1

To a solution of 2Am4CBza-L-1c (150 mg, 160 umol, 1.0 eq) and (2,3,5,6-tetrafluoro-4-hydroxy-phenyl)sulfonyloxysodium (129 mg, 480 umol, 3.0 eq) in DCM (2 mL) and DMA (1 mL) was added EDCI (123 mg, 640 umol, 4.0 eq), and then stirred at 20°C for 1 hr. The mixture was concentrated in vacuum and filtered. The residue was purified by prep-HPLC(column: Phenomenex Luna 80*30mm*3um;mobile phase: [water(0.1%TFA)-ACN];B%: 10%-35%,8min) to afford 2Am4CBza-L-1 (74 mg, 57.9 umol, 36.1% yield, TFA) as yellow oil. ^{1}H NMR (MeOD,400MHz)δ 9.24 (s, 3H), 9.19 (s, 2H), 7.91-7.73 (m, 3H), 7.47 (s, 1H), 4.01 (br t, J = 4.8 Hz, 2H), 3.88 (t, J = 6.0 Hz, 2H), 3.83-3.75 (m, 4H), 3.71-3.55 (m, 40H), 3.48 (s, 2H), 3.32 (s, 2H), 2.99 (t, J = 5.6 Hz, 2H), 1.89-1.70 (m, 2H), 1.03 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 1165.4 (calculated); LC/MS [M+H] 1165.5 (observed).

Example 2 Synthesis of 4-((4-(2-amino-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,10,13,16,19,22,25,28,31,34,37,40-dodecaoxa-4,8-diazatritetracontan-43-oyl)oxy)-2,3,5,6-tetrafluorobenzenesulfonic acid, 2Am4CBza-L-2



Preparation of tert-butyl (2-((2-amino-8-bromo-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-2b

2-Amino-8-bromo-3H-benzo[b]azepine-4-carboxylic acid, 2Am4CBza-L-2a (0.287 g, 1.02 mmol, 1 equiv.) and tert-butyl (2-((propylamino)oxy)ethyl)carbamate (0.223 g, 1.02 mmol, 1 equiv.) were suspended in 1 ml DMSO. N-methylimidazole (0.4 ml, 5.1 mmol, 5 equiv.) and 1-[Bis(dimethylamino)methylene]-1H-1,2,3-triazolo[4,5-b]pyridinium 3-oxide hexafluorophosphate, Hexafluorophosphate Azabenzotriazole Tetramethyl Uronium, HATU (0.427 g, 1.12 mmol, 1.1 equiv.) were added and the suspension stirred at room temperature. The reaction was diluted with 1:1 water:acetonitrile and purified by HPLC to give 2Am4CBza-L-2b (0.143 g, 0.30 mmol, 29%). LC/MS [M+H] 481.15/483.14 (calculated); LC/MS [M+H] 481.31/483.24 (observed).

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-2c

2Am4CBza-L-2b (0.030 g, 0.063 mmol, 1 equiv.) was dissolved to 5 mM in methanol. The solution was dehydrohalogenated using an H-Cube Pro fitted with a 30 mm 10% Pd/C cartridge (50 °C, 50 bar H_2, 1 ml/min flow rate). The resulting solution was concentrated, suspended in minimal TFA, and then concentrated and triturated with diethyl ether to give 2Am4CBza-L-2c as a TFA salt (0.0296 g, 0.056 mmol, 89%). LC/MS [M+H] 303.18 (calculated); LC/MS [M+H] 303.23 (observed).

Preparation of 4-(2-amino-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,10,13,16,19,22,25,28,31,34,37,40-dodecaoxa-4,8-diazatritetracontan-43-oic acid, 2Am4CBza-L-2d

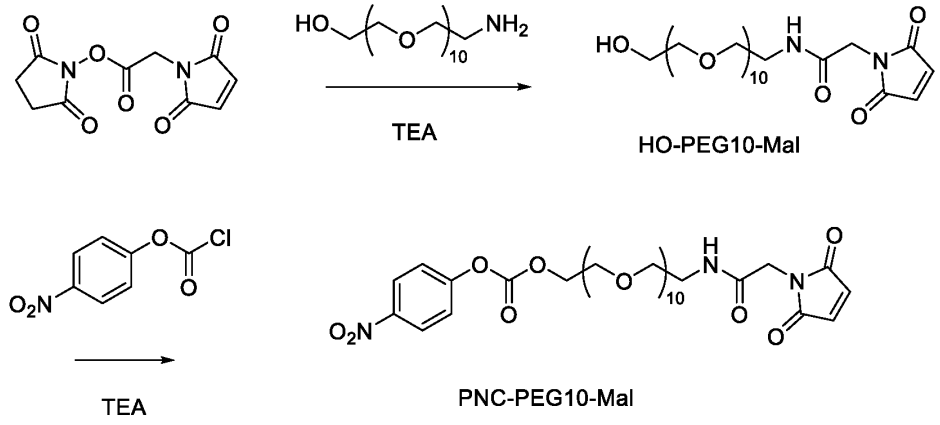
2Am4CBza-L-2c (0.0046 g, 0.0087 mmol, 1 equiv.) and PNC-PEG10-CO2tBu (0.0114 g, 0.0152 mmol, 1.3 equiv.) were dissolved in DMF (0.5 ml). Triethylamine (0.021 ml, 0.152 mmol, 17.5 equiv.) was added, and the reaction stirred at room temperature. Upon consumption of amine starting material, the reaction mixture was concentrated to remove TEA and purified by HPLC. The resulting residue was suspended in minimal TFA and concentrated to give 2Am4CBza-L-2d (0.0026, 0.003 mmol, 35%). LC/MS [M+H] 859.46 (calculated); LC/MS [M+H] 859.84 (observed).

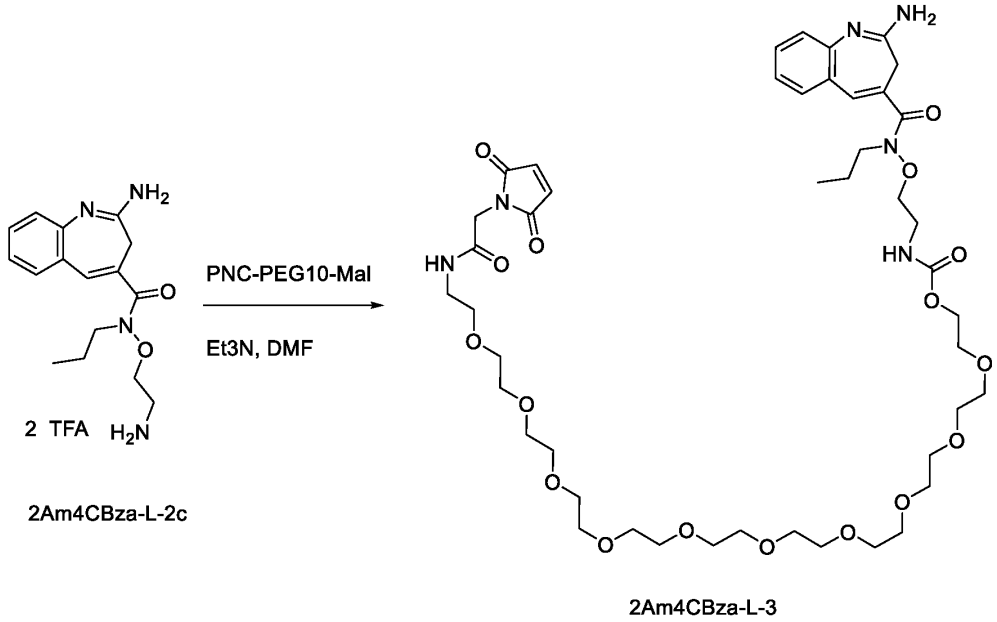
Preparation of 2Am4CBza-L-2

2Am4CBza-L-2d (0.0026 g, 0.003 mmol, 1 equiv.) and sodium 2,3,5,6-tetrafluoro-4-hydroxybenzenesulfonate (0.004 g, 0.015 mmol, 5 equiv.) were dissolved in DMF (0.5 ml). Collidine (0.004 ml, 0.030 mmol, 10 equiv.) was added, followed by EDC (0.009 g, 0.0047 mmol, 1.55 equiv.). The reaction was stirred at room temperature and monitored by LCMS, then diluted with water and purified by reverse-phase HPLC to give 2Am4CBza-L-2 (0.0026 g, 0.0024 mmol, 79%). LC/MS [M+H] 1087.41 (calculated); LC/MS [M+H] 1087.52 (observed).

Example 3 Synthesis of 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (2-((2-amino-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-3

Preparation of 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (4-nitrophenyl) carbonate, PNC-PEG10-Mal





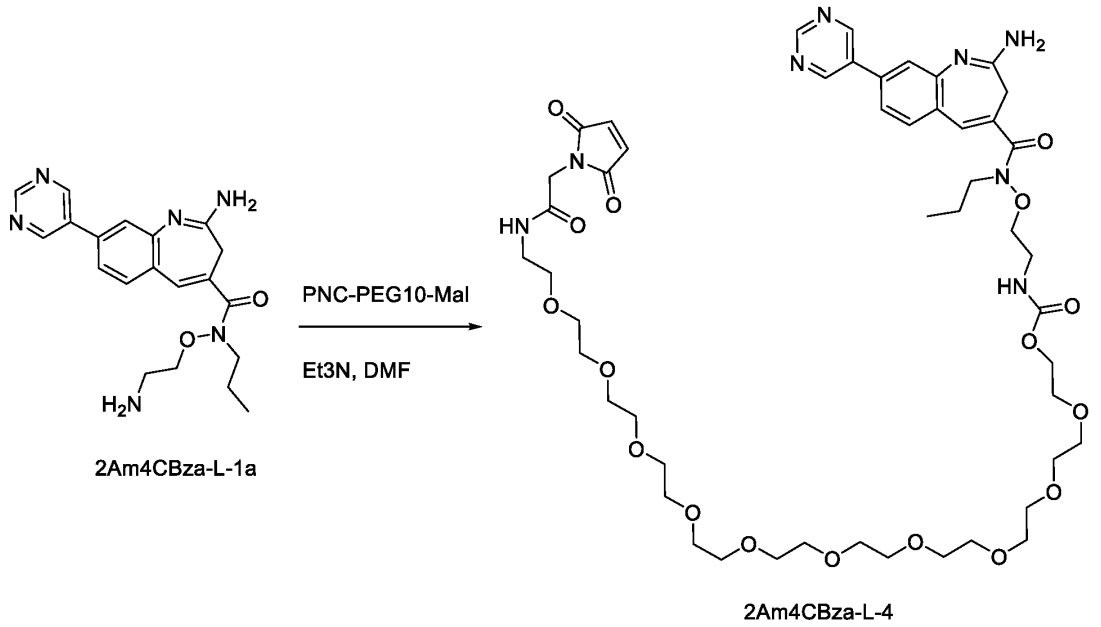
32-Amino-3,6,9,12,15,18,21,24,27,30-decaoxadotriacontan-1-ol, (0.481 g, 0.96 mmol, 1 equiv.) was dissolved in acetonitrile. TEA (0.67 ml, 4.79 mmol, 5 equiv.) was added, followed by 2,5-dioxopyrrolidin-1-yl-2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)acetate (0.266 g, 1.05 mmol, 1.1 equiv.). Upon consumption of the amine starting material, the reaction was concentrated and purified by reverse-phase flash chromatography to give 2-(2,5-Dioxo-2,5-dihydro-1H-pyrrol-1-yl)-N-(32-hydroxy-3,6,9,12,15,18,21,24,27,30-

decaoxadotriacontyl)acetamide, HO-PEG10-Mal (0.255 g, 0.399 mmol, 42%). LC/MS [M+H] 639.33 (calculated); LC/MS [M+H] 639.73 (observed).

HO-PEG10-Mal (0.201 g, 0.315 mmol, 1 equiv.) was dissolved in acetonitrile. TEA (0.22 ml, 1.57 mmol, 5 equiv.) was added, followed by 4-nitrophenyl chloroformate (0.070 g, 0.346 mmol, 1.1 equiv.). Upon consumption of the alcohol, the reaction was concentrated and purified by HPLC to give PNC-PEG10-Mal (0.117 g, 0.146 mmol, 46%). LC/MS [M+H] 804.34 (calculated); LC/MS [M+H] 804.72 (observed).

2-Amino-N-(2-aminoethoxy)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-2c (0.0067 g, 0.013 mmol, 1 equiv.) and PNC-PEG10-Mal (0.0178 g, 0.022 mmol, 1.75 equiv.) were dissolved in DMF (0.5 ml). Triethylamine (0.015 ml, 0.11 mmol, 8.8 equiv.) was added, and the reaction stirred at room temperature. Upon consumption of amine starting material, the reaction mixture was concentrated to remove TEA and purified by HPLC to give 2Am4CBza-L-3 (0.0101 g, 0.010 mmol, 83%). LC/MS [M+H] 967.49 (calculated); LC/MS [M+H] 967.53 (observed).

Example 4 Synthesis of 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (2-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-4



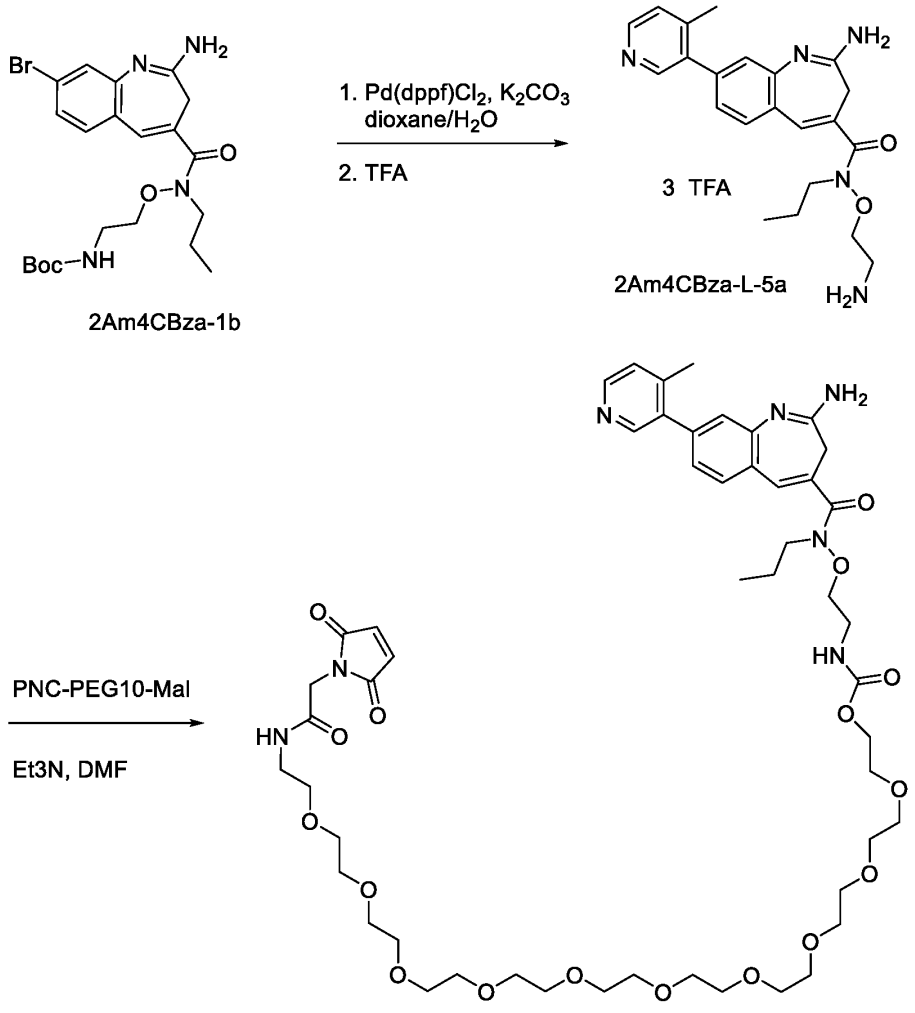
2Am4CBza-L-1a

2Am4CBza-L-4

2-Amino-N-(2-aminoethoxy)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-1a (0.0074 g, 0.012 mmol, 1 equiv.) and 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (4-nitrophenyl)carbonate, PNC-PEG10-Mal (0.016 g, 0.019 mmol, 1.75 equiv.) were dissolved in DMF (0.5 ml). Triethylamine (0.014 ml, 0.097 mmol, 5 equiv.) was added, and the reaction

stirred at room temperature. Upon consumption of amine starting material, the reaction mixture was concentrated to remove TEA and purified by HPLC to give 2Am4CBza-L-4 (0.0017 g, 0.0016 mmol, 14%). LC/MS [M+H] 1045.51 (calculated); LC/MS [M+H] 1045.57 (observed).

Example 5 Synthesis of 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (2-((2-amino-8-(4-methylpyridin-3-yl)-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-5



2Am4CBza-1b

2Am4CBza-L-5

Preparation of 2-amino-N-(2-aminoethoxy)-8-(4-methylpyridin-3-yl)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-5a

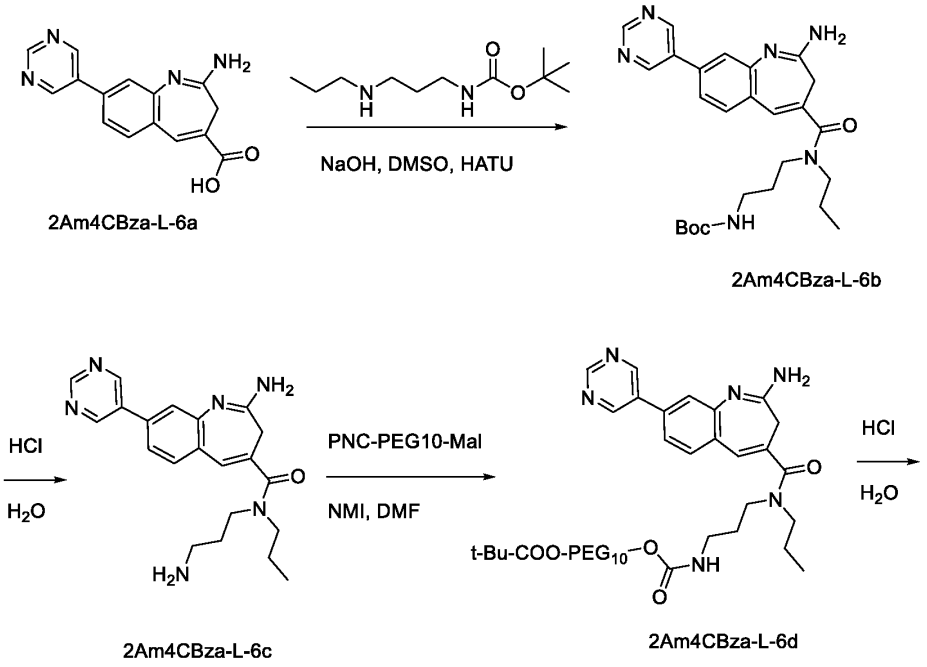
Tert-butyl (2-((2-amino-8-bromo-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-1b (0.03 g, 0.062 mmol, 1 equiv.), (4-methylpyridin-3-yl)boronic acid (0.017 g, 0.124 mmol, 2 equiv.), potassium carbonate (0.054 g,

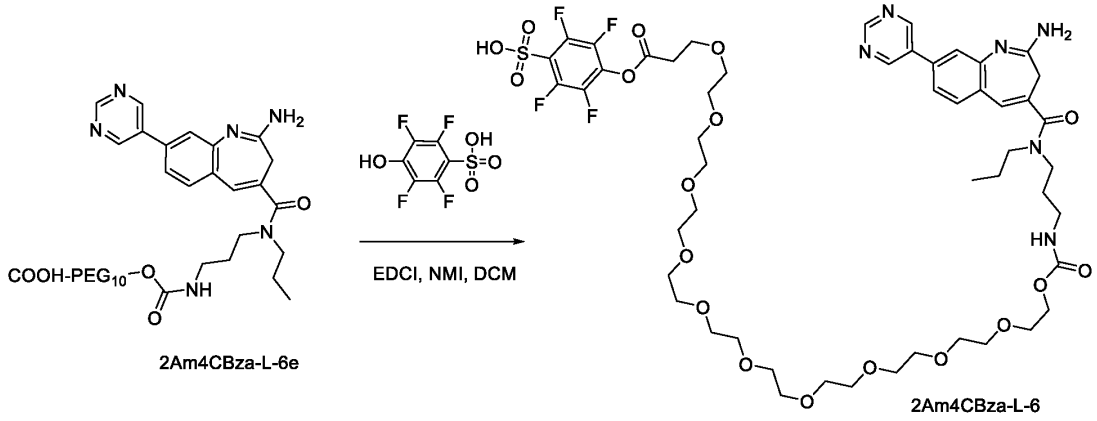
0.393 mmol, 6.3 equiv.), and [1,1′-Bis(diphenylphosphino)ferrocene]dichloropalladium(II) (0.0023 g, 0.003 mmol, 0.05 equiv.) were suspended in 4:1 dioxane:water (5 ml). The reaction was heated to 80 °C. The reaction mixture was concentrated to remove dioxane and purified by HPLC. After lyophilization, the resulting product was allowed to stand for 10 minutes in minimal TFA, then concentrated and triturated with diethyl ether to give 2Am4CBza-L-5a as a TFA salt (0.0124 g, 0.017 mmol, 27%). LC/MS [M+H] 394.22 (calculated); LC/MS [M+H] 394.36 (observed).

Preparation of 2Am4CBza-L-5

2Am4CBza-L-5a (0.0124 g, 0.017 mmol, 1 equiv.) and 1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2-oxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3-azapentatriacontan-35-yl (4-nitrophenyl)carbonate, PNC-PEG10-Mal (0.0253 g, 0.032 mmol, 1.88 equiv.) were dissolved in DMF (0.5 ml). Triethylamine (0.022 ml, 0.16 mmol, 9.2 equiv.) was added, and the reaction stirred at room temperature. Upon consumption of amine starting material, the reaction mixture was concentrated to remove TEA and purified by HPLC to give 2Am4CBza-L-5 (0.0061 g, 0.0057 mmol, 34%). LC/MS [M+H] 1058.53 (calculated); LC/MS [M+H] 1058.76 (observed).

Example 6 Synthesis of 4-((40-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-35-oxo-4,7,10,13,16,19,22,25,28,31,34-undecaoxa-36,40-diazatritetracontanoyl)oxy)-2,3,5,6-tetrafluorobenzenesulfonic acid, 2Am4CBza-L-6





Preparation of tert-butyl (3-(2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)propyl)carbamate, 2Am4CBza-L-6b

To a stirring solution of 2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxylic acid, 2Am4CBza-L-6a (60 mg, 0.28 mmol, 1 eq.) in DMSO (2 mL) was added 2N NaOH (0.81 mL, 0.81 mmol, 3 eq.). To this solution was added tert-butyl (3-(propylamino)propyl)carbamate (78 mg, 0.28, 1 eq.). To this stirring mixture was added HATU (169 mg, 0.44 mmol, 1.6 eq.). After 15 minutes the crude product was purified on reverse phase HPLC to yield 2Am4CBza-L-6b (54 mg, 0.11 mmol, 41%) as a clear solid. LC/MS [M+H] 479.27(calculated); LC/MS [M+H] 479.42 (observed).

Preparation of 2-amino-N-(3-aminopropyl)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide hydrochloride, 2Am4CBza-L-6c

To 2Am4CBza-L-6b (54 mg, 0.11 mmol, 1 eq.) was added 6N HCl (1 mmol). The reaction was stirred for 10 minutes then the solvent was removed under reduced pressure. The solid was azeotroped two times with acetonitrile (2 mL) to yield 2Am4CBza-L-6c (44 mg, 0.093. mmol, 85%). LC/MS [M+H] 379.22 (calculated); LC/MS [M+H] 379.22 (observed).

Preparation of tert-butyl 40-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-35-oxo-4,7,10,13,16,19,22,25,28,31,34-undecaoxa-36,40-diazatritetracontanoate, 2Am4CBza-L-6d

To a solution of 2Am4CBza-L-6c (54 mg, 0.16 mmol) and 1-methylimidazole (40 mg, 0.48 mmol mmol, 3 eq.) was added tert-butyl (PEG_{11}-p-nitrophenylcarbonate) carboxylate, PNC-PEG10-Mal and stirred for 45 minutes. Reverse phase HPLC provide 2Am4CBza-L-6d (54 mg, 0.054 mmol, 52%). LC/MS [M+H] 991.55 (calculated); LC/MS [M+H] 991.66 (observed).

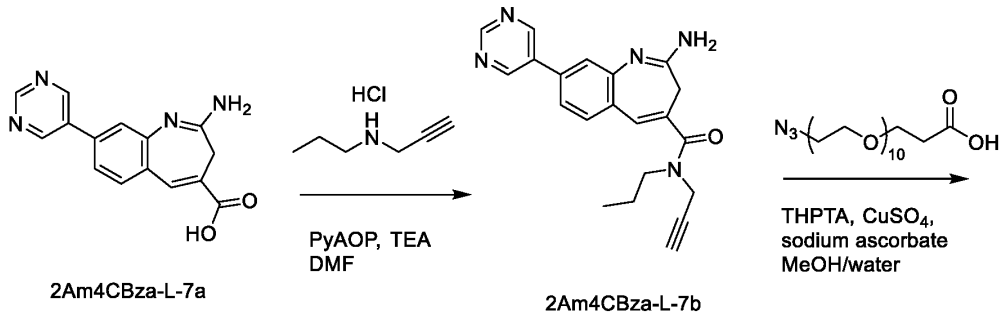
Preparation of 40-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-35-oxo-4,7,10,13,16,19,22,25,28,31,34-undecaoxa-36,40-diazatritetracontanoic acid, 2Am4CBza-L-6e

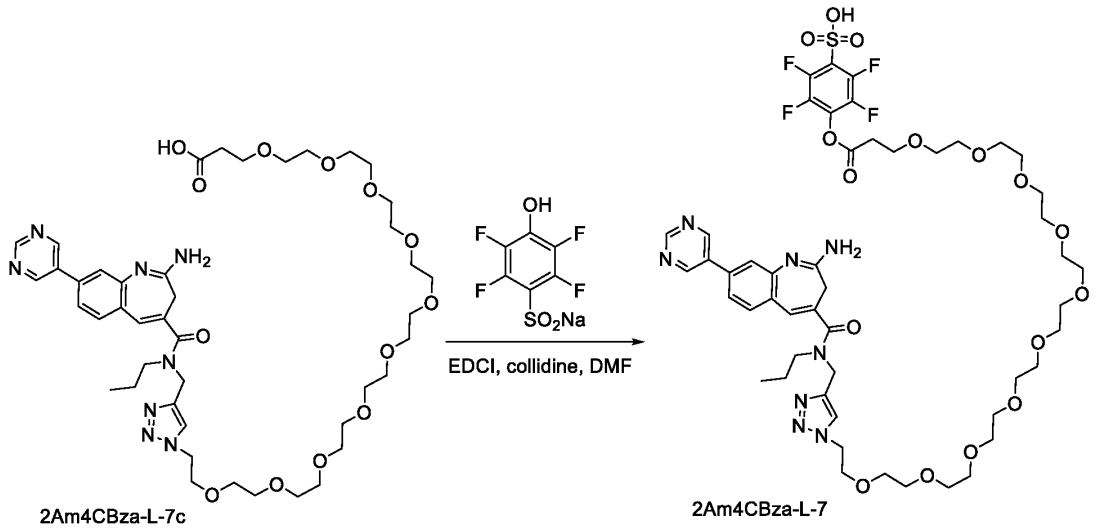
2Am4CBza-L-6d (54 mg, 0.054 mmol, 1 eq) was stirred in 6 N HCl (1 mL) for 25 minutes. After removal of water and azeotroping two times with acetonitrile to give 2Am4CBza-L-6e (32 mg, 0.33 mmol, 68%) as a clear solid. LC/MS [M+H] 935.49 (calculated); LC/MS [M+H] 935.79 (observed).

Preparation of 2Am4CBza-L-6

To a solution of 2Am4CBza-L-6e (32 mg, 0.033 mmol, 1 eq) in DMF (1 mL) was added 0.1 mL of a solution containing solution of sodium 2,3,5,6-tetrafluoro-4-hydroxybenzenesulfonate (1 mmol) EDC (2 mmol) and 1-methylimidazole (3 mmol) in 1 ml DMF. The reaction was stirred for 2 hours at room temperature for 2 hours then purified on reverse phase chromatography to obtain 2Am4CBza-L-6 (18 mg, 0.015 mmol, 45%) as a clear solid. LC/MS [M+H] 1163.44 (calculated); LC/MS [M+H] 1163.46 (observed).

Example 7 Synthesis of 4-((1-(4-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)methyl)-1H-1,2,3-triazol-1-yl)-3,6,9,12,15,18,21,24,27,30-decaoxatritriacontan-33-oyl)oxy)-2,3,5,6-tetrafluorobenzenesulfonic acid, 2Am4CBza-L-7





Preparation of 2-amino-N-(prop-2-yn-1-yl)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-7b

To a mixture of 2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxylic acid, 2Am4CBza-L-7a (0.067 g, 0.24 mmol, 1 eq) and N-propylprop-2-yn-1-aminium hydrochloride (0.032 g, 0.24 mmol, 1 eq) in DMF was added ((7-azabenzotriazol-1-yloxy)tripyrrolidinophosphonium hexafluorophosphate), PyAOP, CAS Reg. No. 156311-83-0 (0.15 g, 0.29 mmol, 1.2 eq) and TEA (0.17 ml, 1.2 mmol, 5 eq). The mixture was diluted with water and acetonitrile, purified by reverse-phase HPLC, and lyophilized to give 2-amino-N-(prop-2-yn-1-yl)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide (0.011 g, 0.03 mmol, 13% yield). LC/MS [M+H] 360.18 (calculated); LC/MS [M+H] 360.32 (observed).

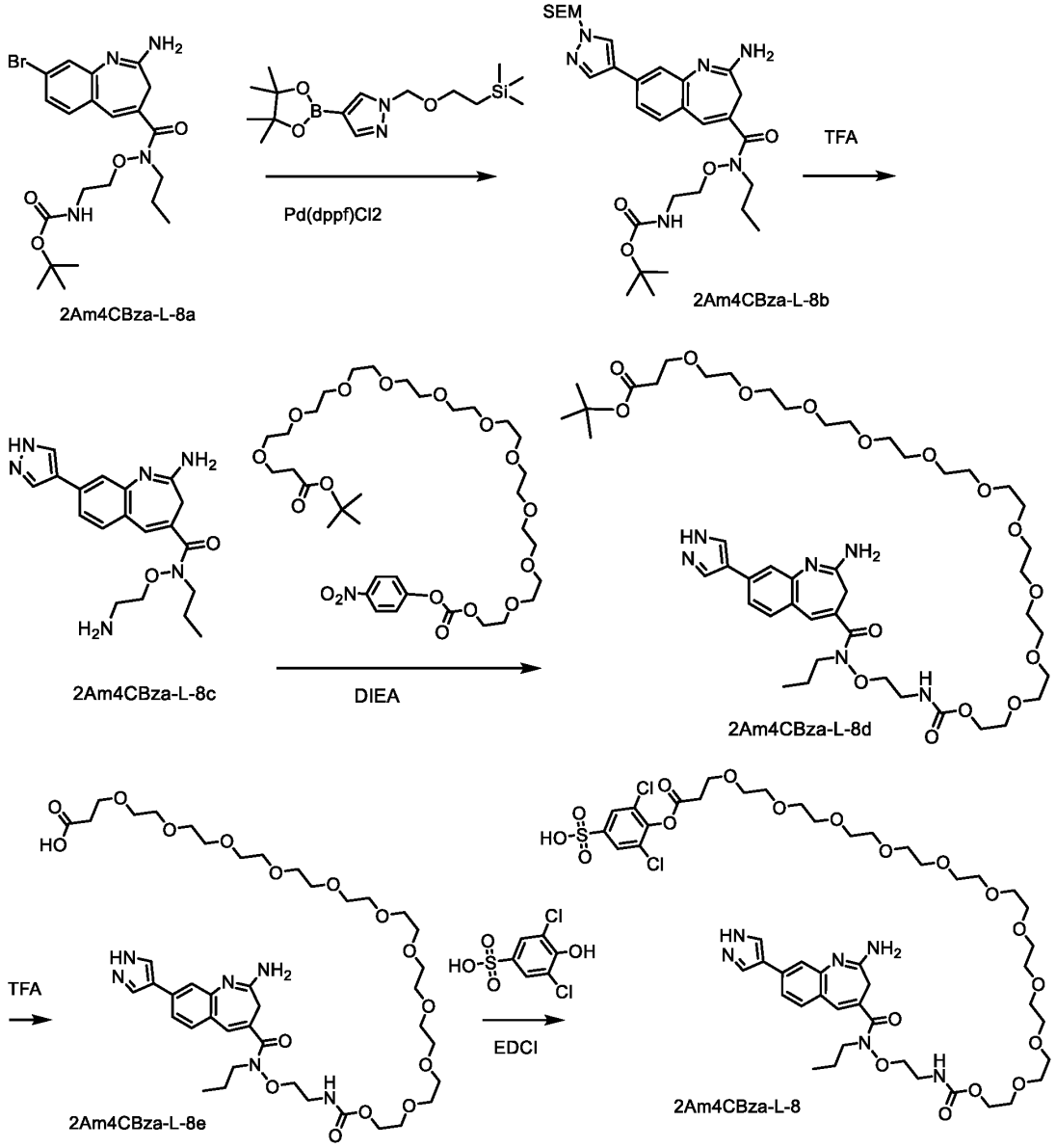
Preparation of 1-(4-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)methyl)-1H-1,2,3-triazol-1-yl)-3,6,9,12,15,18,21,24,27,30-decaoxatritriacontan-33-oic acid, 2Am4CBza-L-7c

To a mixture of 2Am4CBza-L-7b (0.011 g, 0.031 mmol, 1.08 eq) and 1-azido-3,6,9,12,15,18,21,24,27,30-decaoxatritriacontan-33-oic acid (0.016 g, 0.028 mmol, 1 eq) in 1:1 methanol:water (1 ml) was added a mixture of sodium ascorbate (5.6 mg, 0.028 mmol, 1 eq), $CuSO_4$ (2.3 mg, 0.014 mmol, 0.5 eq), and tris-hydroxypropyltriazolylmethylamine, THPTA (0.018 g, 0.042 mmol, 1.5 eq) in 1:1 methanol:water (1 ml). After three hours, the reaction mixture was purified by reverse-phase HPLC and lyophilized to give 2Am4CBza-L-7c (0.021 g, 0.023 mmol, 80% yield). LC/MS [M+H] 915.48 (calculated); LC/MS [M+H] 915.76 (observed).

Preparation of 2Am4CBza-L-7

To a mixture of 2Am4CBza-L-7c (0.0206 g, 0.023 mmol, 1 eq) and sodium 2,3,5,6-tetrafluoro-4-hydroxybenzenesulfonate, STP (0.030 g, 0.113 mmol, 5 eq) in DMF (0.5 ml) was added collidine (0.03 ml, 0.225 mmol, 10 eq), followed by EDCI (6.4 mg, 0.034 mmol, 1.5 eq). The reaction was stirred at room temperature and monitored by LCMS, then diluted with water and purified by reverse-phase HPLC to give 2Am4CBza-L-7 (12.9 mg, 0.011 mmol, 50%). LC/MS [M+H] 1143.43 (calculated); LC/MS [M+H] 1143.50 (observed).

Example 8 Synthesis of 4-[3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-amino-8-(1H-pyrazol-4-yl)-3H-1-benzazepine-4-carbonyl]-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoyloxy]-3,5-dichloro-benzenesulfonic acid, 2Am4CBza-L-8



Preparation of tert-butyl N-[2-[[2-amino-8-[1-(2-trimethylsilylethoxymethyl)pyrazol-4-yl]-3H-1-benzazepine-4-carbonyl]-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-8b

To a mixture of tert-butyl N-[2-[(2-amino-8-bromo-3H-1-benzazepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-8a (300 mg, 623 umol, 1.0 eq) and trimethyl-[2-[[4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazol-1-yl]methoxy]ethyl]silane (242 mg, 747 umol, 1.2 eq) in dioxane (10 mL) and H_2O (1.5 mL) was added K_2CO_3 (172 mg, 1.25 mmol, 2.0 eq) and $Pd(dppf)Cl_2$ (45.6 mg, 62.3 umol, 0.1 eq) in one portion at 15 °C under N_2, and then stirred at 100 °C for 2 hours. The reaction mixture was concentrated and the residue diluted with H_2O (10 mL) and extracted with EtOAc 30 mL (10 mL x 3). The combined organic layers were washed with brine 10 mL, dried over Na_2SO_4, filtered and concentrated under reduced

pressure to give a residue. The residue was purified by flash silica gel chromatography (ISCO; 25 g SepaFlash® (Santai Technologies, Inc.) Silica Flash Column, Eluent of 0~100% Ethyl acetate/Petroleum ether to 0~20% EtOAc/MeOH gradient: 75 mL/min to give 2Am4CBza-L-8b as yellow solid. ^{1}H NMR (MeOD, 400 MHz) δ8.20 (s, 1H), 7.95 (s, 1H), 7.42-7.34 (m, 2H), 7.33-7.29 (m, 1H), 7.26 (s, 1H), 5.47 (s, 2H), 3.92 (t, J = 5.2 Hz, 2H), 3.72 (t, J = 7.2 Hz, 2H), 3.62 (t, J = 8.0 Hz, 2H), 3.24 (t, J = 5.2 Hz, 2H), 1.83-1.69 (m, 2H), 1.34 (s, 9H), 0.98 (t, J = 7.2 Hz, 3H), 0.91 (t, J = 8.0 Hz, 2H), 0.00 (s, 9H).

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-8-(1H-pyrazol-4-yl)-3H-1-benzazepine-4-carboxamide, 2Am4CBza-L-8c

To a solution of 2Am4CBza-L-8b (400 mg, 667 umol, 1.0 eq) in DCM (8 mL) was added trifluoroacetic acid, TFA (1.52 g, 13.3 mmol, 989 uL, 20.0 eq), and then stirred at 40 °C for 6 hr. The mixture was concentrated to get the crude product 2Am4CBza-L-8c (0.4 g, crude, 2TFA) as yellow oil. LC/MS [M+H] 369.2 (calculated); LC/MS [M+H] 369.2 (observed).

Preparation of tert-butyl 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-amino-8-(1H-pyrazol-4-yl)-3H-1-benzazepine-4-carbonyl]-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy] ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]propanoate, 2Am4CBza-L-8d

To a solution of 2Am4CBza-L-8c (150 mg, 407 umol, 1.0 eq) in DMF (5 mL) was added DIEA (263 mg, 2.04 mmol, 354 uL, 5.0 eq), then tert-butyl 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-(4-nitrophenoxy)carbonyloxyethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]e thoxy]propanoate (306 mg, 407 umol, 1.0 eq) was added. The mixture was stirred at 15 °C for 0.5 hr. The reaction mixture was quenched by addition H_2O (10 mL) at 0°C, and then diluted with EtOAc (5 mL) and extracted with EtOAc (5 mL * 3) to remove the byproduct. The water phase was concentrated under reduced pressure to give the crude product 2Am4CBza-L-8d (0.4 g, crude) as yellow oil. LC/MS [M+H] 981.5 (calculated); LC/MS [M+H] 981.6 (observed).

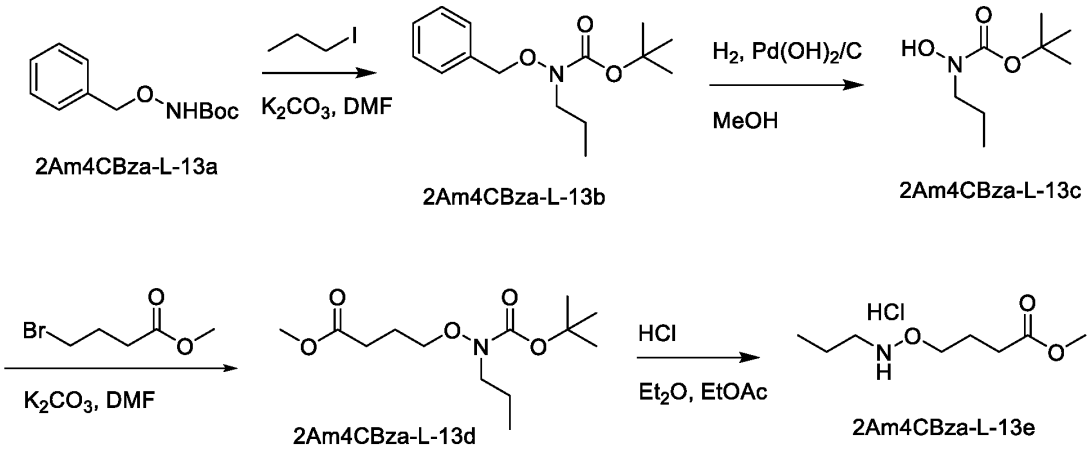
Preparation of 3-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-amino-8-(1H-pyrazol-4-yl)-3H-1-benzazepine-4-carbonyl]-propyl-amino]oxyethylcarbamoyloxy]ethoxy]ethoxy]ethoxy]ethoxy] ethoxy]ethoxy]ethoxy] ethoxy]ethoxy]ethoxy]propanoic acid, 2Am4CBza-L-8e

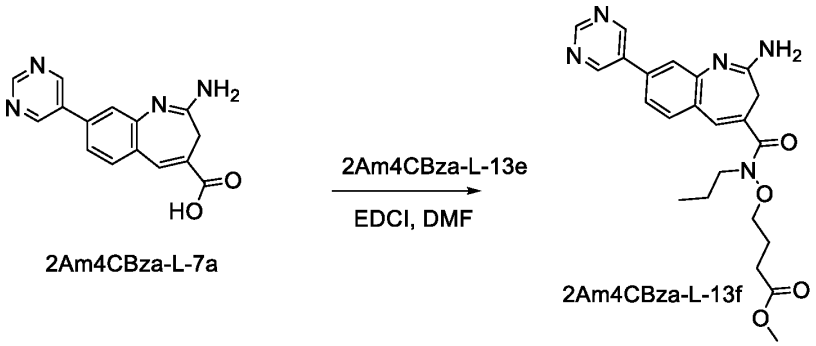
To a solution of 2Am4CBza-L-8d (0.4 g, 407 umol, 1.0 eq) in CH_3CN (5 mL) and H_2O (1 mL) was added TFA (929 mg, 8.15 mmol, 603 uL, 20.0 eq), and then stirred at 80°C for 4 hr. The mixture was concentrated and purified by prep-HPLC (column: Phenomenex Luna 80*30mm*3um;mobile phase: [water(0.1%TFA)-ACN];B%: 10%-35%,8min) to give 2Am4CBza-L-8e (0.1 g, 108 umol, 26.5% yield) as light yellow oil. ^{1}H NMR (MeOD, 400 MHz) δ8.11 (s, 2H), 7.74-7.59 (m, 3H), 7.43 (s, 1H), 3.99 (t, J = 4.8 Hz, 2H), 3.86-3.71 (m, 6H), 3.69-3.52 (m, 38H), 3.51-3.40 (m, 4H), 2.55 (t, J = 6.4 Hz, 2H), 1.88-1.72 (m, 2H), 1.03 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 925.5 (calculated); LC/MS [M+H] 925.6 (observed).

Preparation of 2Am4CBza-L-8

To a solution of 2Am4CBza-L-8e (40 mg, 43.2 umol, 1.0 eq) in DCM (1 mL) and DMA (0.2 mL) was added diisopropylethylamine, DIEA (5.59 mg, 43.2 umol, 7.53 uL, 1.0 eq) and 3,5-dichloro-4-hydroxy-benzenesulfonic acid (84.0 mg, 345 umol, 8.0 eq). Then EDCI (41.4 mg, 216 umol, 5.0 eq) was added and the mixture was stirred at 15 °C for 1 hr. The mixture was concentrated. The residue was purified by prep-HPLC (column: Phenomenex Luna 80*30mm*3um; mobile phase: [water (TFA)-ACN]; B%: 5%-40%, 8min) to give 2Am4CBza-L-8 as light yellow oil. ^{1}H NMR (MeOD, 400 MHz) δ8.14 (s, 2H), 7.84 (s, 2H), 7.71-7.65 (m, 2H), 7.62-7.57 (m, 1H), 7.41 (s, 1H), 3.98 (t, J = 4.8 Hz, 2H), 3.90 (t, J = 6.0 Hz, 2H), 3.85-3.79 (m, 2H), 3.76 (t, J = 7.2 Hz, 2H), 3.70-3.52 (m, 38H), 3.48-3.40 (m, 4H), 2.96 (t, J = 6.0 Hz, 2H), 1.83-1.74 (m, 2H), 1.02 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 1149.4 (calculated); LC/MS [M+H] 1149.4 (observed).

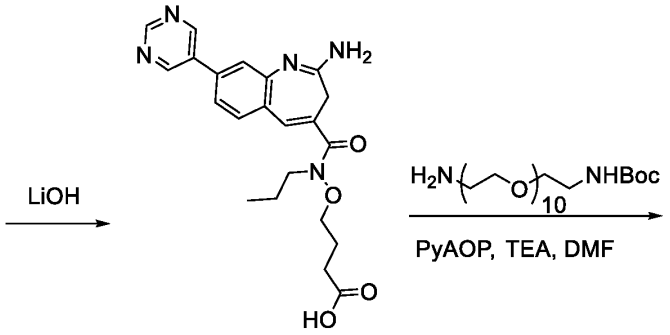
Example 13 Synthesis of 2-amino-N-((1-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-2,37-dioxo-6,9,12,15,18,21,24,27,30,33-decaoxa-3,36-diazatetracontan-40-yl)oxy)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-13



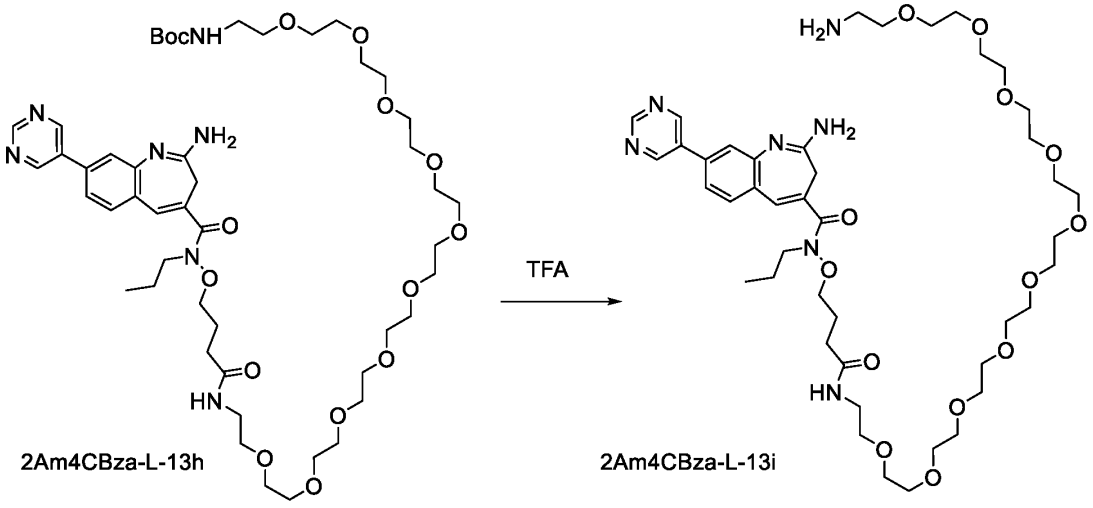


2Am4CBza-L-7a

2Am4CBza-L-13f

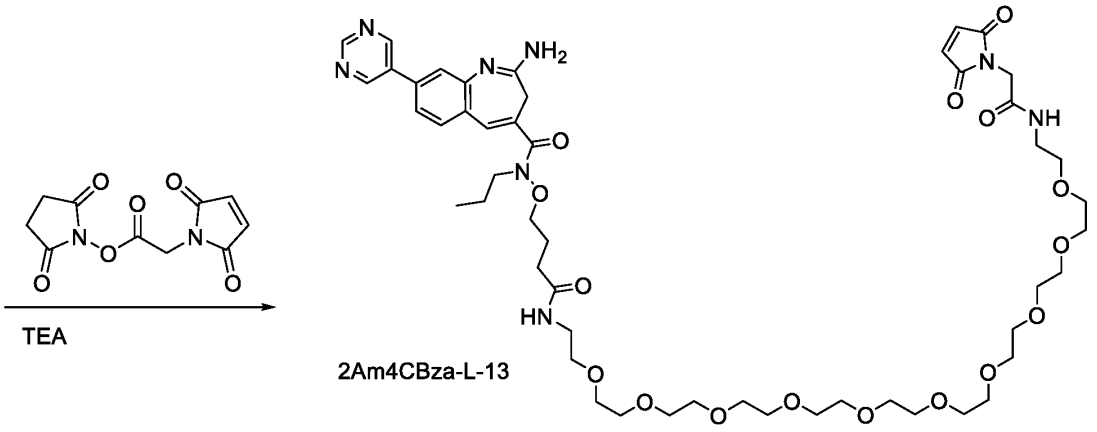


2Am4CBza-L-13g



2Am4CBza-L-13h

2Am4CBza-L-13i



Preparation of tert-butyl (benzyloxy)(propyl)carbamate, 2Am4CBza-L-13b

To a mixture of tert-butyl (benzyloxy)carbamate, 2Am4CBza-L-13a (15 g, 67 mmol, 1 eq) in DMF were added propyl iodide (13.1 ml, 134 mmol, 2 eq) and K_2CO_3 (37 g, 269 mmol, 4 eq). The reaction was stirred at 50 °C and monitored by LCMS. The reaction mixture was filtered, concentrated, and purified by column chromatography to give 2Am4CBza-L-13b. LC/MS [M+2H-tBu] 210.11 (calculated); LC/MS [M+2H-tBu] 210.17 (observed).

Preparation of tert-butyl hydroxy(propyl)carbamate, 2Am4CBza-L-13c

2Am4CBza-L-13b was dissolved in MeOH and hydrogenated by H-cube (20% $Pd(OH)_2/C$ cartridge, 1 ml/min flow rate, 50 °C, 50 bar H_2). The product solution was concentrated to give crude 2Am4CBza-L-13c. LC/MS [M+2H-tBu] 120.07 (calculated); LC/MS [M+2H-tBu] 120.06 (observed).

Preparation of methyl 4-(((tert-butoxycarbonyl)(propyl)amino)oxy)butanoate, 2Am4CBza-L-13d

To a mixture of 2Am4CBza-L-13c (0.032 g, 0.18 mmol, 1 eq) and methyl 4-bromobutanoate (0.034 ml, 0.27 mmol, 1.5 eq) in DMF was added K_2CO_3 (0.076 g, 0.55 mmol, 3 eq). The reaction mixture was stirred at 50 °C, then filtered, concentrated, and purified by column chromatography to give 2Am4CBza-L-13d. LC/MS [M+Na] 298.16 (calculated); LC/MS [M+Na] 298.25 (observed).

Preparation of O-(4-methoxy-4-oxobutyl)-N-propylhydroxylammonium hydrochloride, 2Am4CBza-L-13e

2Am4CBza-L-13d was dissolved in 1 M HCl in EtOAc. The reaction was monitored by LCMS, then concentrated to give crude 2Am4CBza-L-13e. LC/MS [M+H] 176.13 (calculated); LC/MS [M+H] 176.12 (observed).

Preparation of methyl 4-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)oxy)butanoate, 2Am4CBza-L-13f

To a mixture of 2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxylic acid, 2Am4CBza-L-7a (0.15 g, 0.535 mmol, 1 eq) and O-(4-methoxy-4-oxobutyl)-N-propylhydroxylammonium hydrochloride, 2Am4CBza-L-13e (0.453 g, 2.14 mmol, 4 eq) in DMF was added EDCI (0.205 g, 1.07 mmol, 2 eq). The reaction mixture was monitored by LCMS, then purified by reverse phase HPLC to give 2Am4CBza-L-13f (96.8 mg, 0.221 mmol, 41%). LC/MS [M+H] 438.21 (calculated); LC/MS [M+H] 438.39 (observed).

Preparation of 4-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)oxy)butanoic acid, 2Am4CBza-L-13g

2Am4CBza-L-13f (96.8 mg, 0.221 mmol, 1 eq) and lithium hydroxide, LiOH (26.5 mg, 1.1 mmol, 5 eq) were suspended in 1:1 H_2O:THF with vigorous stirring. MeOH was added until the mixture was homogeneous. The reaction mixture was monitored by LCMS, then concentrated to remove organic solvents and purified by reverse phase HPLC to give 2Am4CBza-L-13g (0.0694 g, 0.164 mmol, 74%).

Preparation of tert-butyl (39-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-34-oxo-3,6,9,12,15,18,21,24,27,30,38-undecaoxa-33,39-diazadotetracontyl)carbamate, 2Am4CBza-L-13h

To a mixture of 2Am4CBza-L-13g (2 mg, 4.7 μmol, 1 eq) and tert-butyl (32-amino-3,6,9,12,15,18,21,24,27,30-decaoxadotriacontyl)carbamate (4.3 mg, 7.1 μmol, 1.5 eq) in DMF (0.5 ml) was added PyAOP (3.7 mg, 7.1 μmol, 1.5 eq) and triethylamine, TEA (6.6 μl, 0.047 mmol, 10 eq). The mixture was diluted with water and acetonitrile, purified by reverse-phase HPLC, and lyophilized to give 2Am4CBza-L-13h, which was immediately carried forward. LC/MS [M+H] 1006.57 (calculated); LC/MS [M+H] 1006.90 (observed).

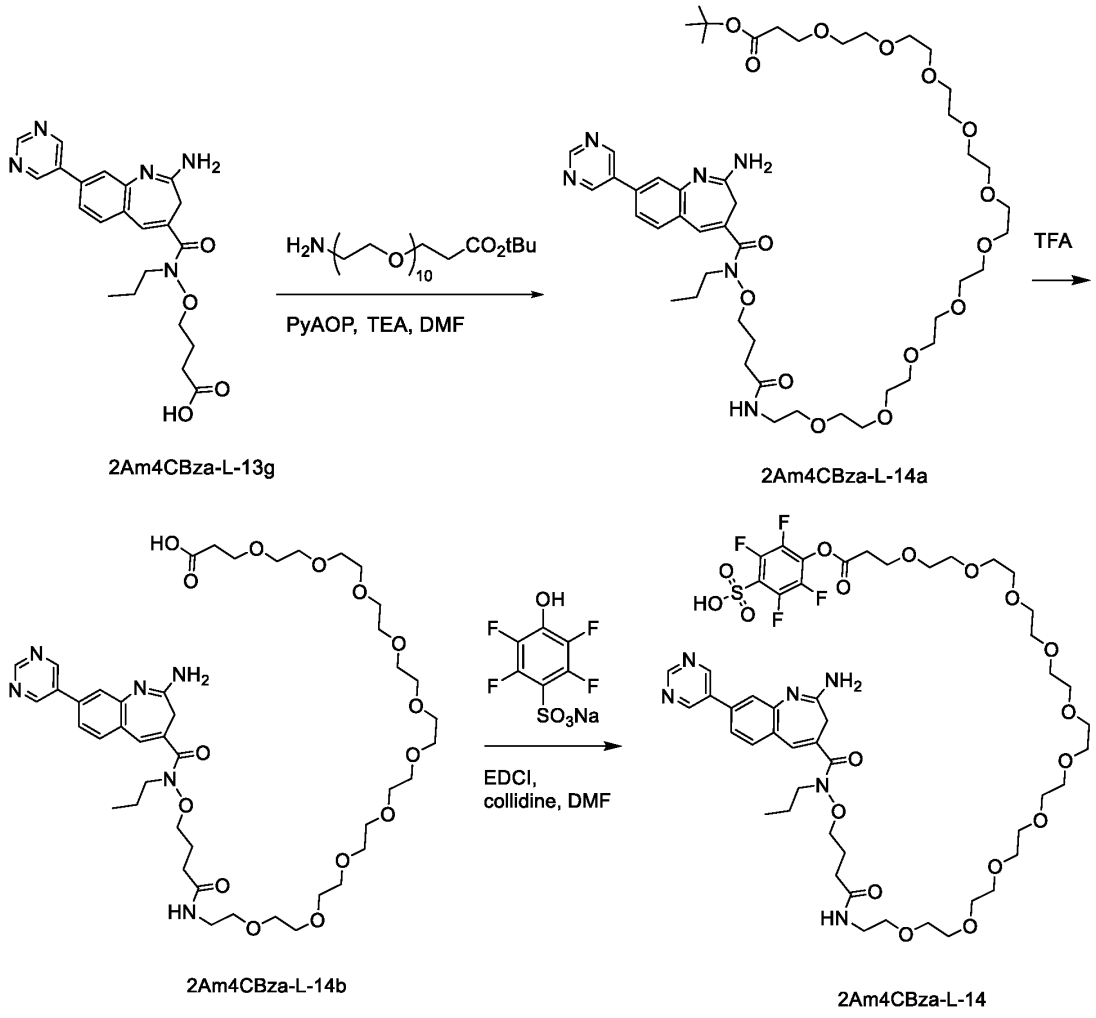
Preparation of 2-amino-N-((1-amino-34-oxo-3,6,9,12,15,18,21,24,27,30-decaoxa-33-azaheptatriacontan-37-yl)oxy)-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-13i

2Am4CBza-L-13h was dissolved in minimal TFA. After 15 minutes, the reaction mixture was concentrated to give 2Am4CBza-L-13i (2.8 mg, 3.1 μmol, 65% over two steps). LC/MS [M+H] 906.52 (calculated); LC/MS [M+H] 906.81 (observed).

Preparation of 2Am4CBza-L-13

To a solution of 2Am4CBza-L-13i (2.8 mg, 3.1 μmol, 1 eq) in DMF (0.5 ml) was added TEA (4.3 μl, 0.03 mmol, 10 eq), followed by 2,5-dioxopyrrolidin-1-yl 2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)acetate (0.7 mg, 3.1 μmol, 1 eq). The reaction mixture was monitored by LCMS, concentrated, and purified by reverse phase HPLC to give 2Am4CBza-L-13 (3.9 mg, 3.7 μmol, 100%). LC/MS [M+H] 1043.53 (calculated); LC/MS [M+H] 1043.87 (observed).

Example 14 Synthesis of 4-((4-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,13,16,19,22,25,28,31,34,37,40-undecaoxa-4,10-diazatritetracontan-43-oyl)oxy)-2,3,5,6-tetrafluorobenzenesulfonic acid, 2Am4CBza-L-14



Preparation of tert-butyl 4-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,13,16,19,22,25,28,31,34,37,40-undecaoxa-4,10-diazatritetracontan-43-oate, 2Am4CBza-L-14a

To a mixture of 4-((2-amino-N-propyl-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carboxamido)oxy)butanoic acid, 2Am4CBza-L-13g (0.0694 g, 0.164 mmol, 1 eq) and tert-butyl 1-amino-3,6,9,12,15,18,21,24,27,30-decaoxatritriacontan-33-oate (0.096 g, 0.164 mmol, 1 eq) in DMF (0.5 ml) was added TEA (0.23 ml, 1.6 mmol, 10 eq) and PyAOP (0.128 g, 0.25 mmol, 1.5 eq). The reaction mixture was monitored by LCMS, concentrated, and purified by reverse phase HPLC to give 2Am4CBza-L-14a, which was immediately carried forward. LC/MS [M+H] 991.56 (calculated); LC/MS [M+H] 991.85 (observed).

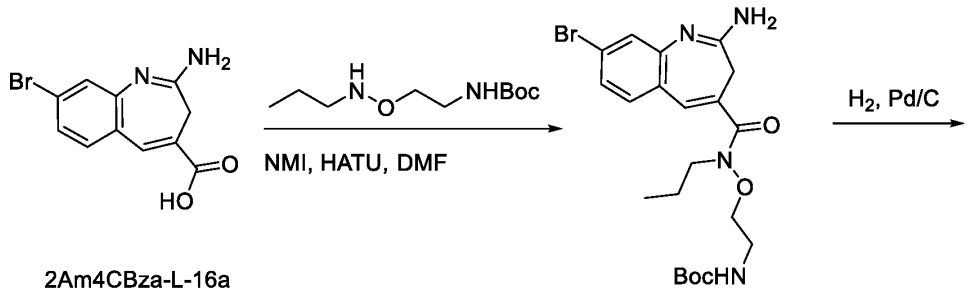
Preparation of 4-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,13,16,19,22,25,28,31,34,37,40-undecaoxa-4,10-diazatritetracontan-43-oic acid, 2Am4CBza-L-14b

2Am4CBza-L-14a was dissolved in minimal TFA. After 15 minutes, the reaction mixture was concentrated to give 2Am4CBza-L-14b (0.0671 g, 0.072 mmol, 44% over two steps). LC/MS [M+H] 935.50 (calculated); LC/MS [M+H] 935.77 (observed).

Preparation of 2Am4CBza-L-14

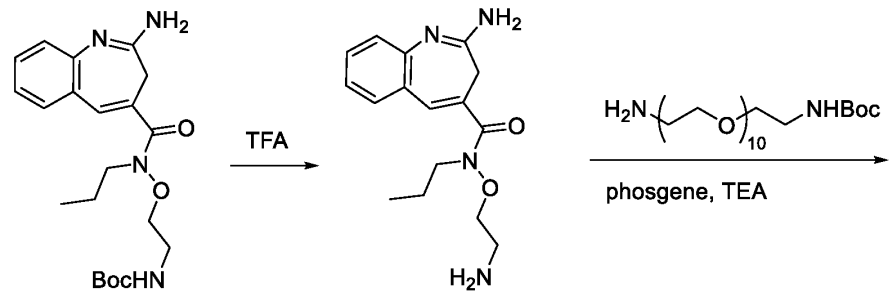
To a mixture of 4-(2-amino-8-(pyrimidin-5-yl)-3H-benzo[b]azepine-4-carbonyl)-9-oxo-5,13,16,19,22,25,28,31,34,37,40-undecaoxa-4,10-diazatritetracontan-43-oic acid and sodium 2,3,5,6-tetrafluoro-4-hydroxybenzenesulfonate, STP (0.096 g, 0.359 mmol, 5 eq) in DMF (0.5 ml) was added collidine (0.095 ml, 0.718 mmol, 10 eq), followed by EDCI (0.021 g, 0.11 mmol, 1.5 eq). The reaction was stirred at room temperature and monitored by LCMS, then diluted with water and purified by reverse-phase HPLC to give 42Am4CBza-L-14 (46.5 mg, 0.040 mmol, 56%). LC/MS [M+H] 1163.45 (calculated); LC/MS [M+H] 1163.75 (observed).

Example 16 Synthesis of 2-amino-N-((40-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)-4,39-dioxo-8,11,14,17,20,23,26,29,32,35-decaoxa-3,5,38-triazatetracontyl)oxy)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-16



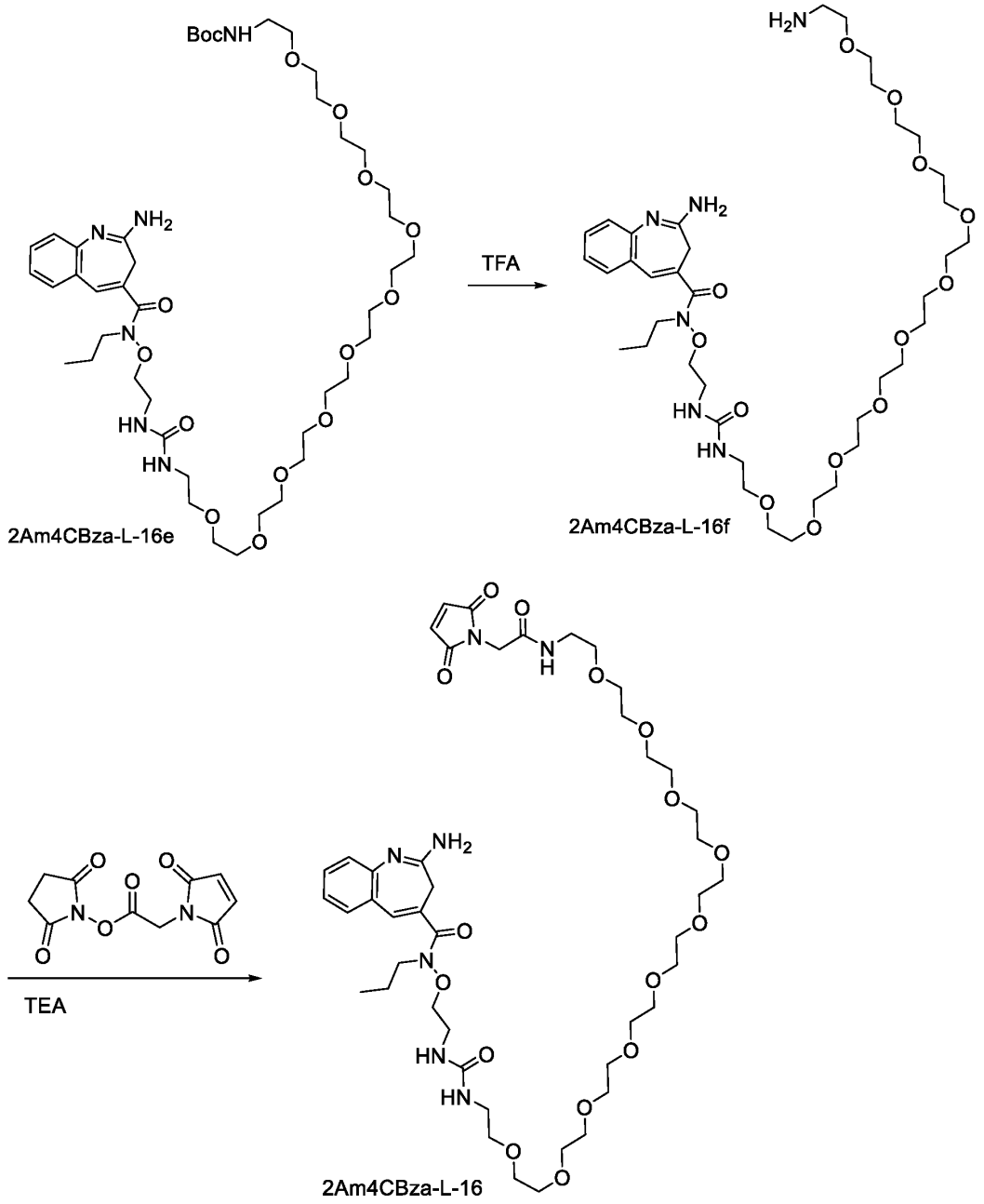
2Am4CBza-L-16a

2Am4CBza-L-16b



2Am4CBza-L-16c

2Am4CBza-L-16d



Preparation of tert-butyl (2-((2-amino-8-bromo-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-16b

To a solution of 2-amino-8-bromo-3H-benzo[b]azepine-4-carboxylic acid, 2Am4CBza-L-16a (0.287 g, 1.0 mmol, 1 eq) and tert-butyl (2-((propylamino)oxy)ethyl)carbamate (0.223 g, 1.0 mmol, 1 eq) in DMF were added N-methylimidazole, NMI (0.41 ml, 5.1 mmol, 5 eq) and HATU (0.427 g, 1.12 mmol, 1.1 eq). The reaction was monitored by LCMS, concentrated, and purified by HPLC to give 2Am4CBza-L-16b (0.14 g, 0.30 mmol, 29%). LC/MS [M+H] 481.15/483.14 (calculated); LC/MS [M+H] 481.31/483.25 (observed).

Preparation of tert-butyl (2-((2-amino-N-propyl-3H-benzo[b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-16c

2Am4CBza-L-16b (0.030 g, 0.063 mmol, 1 eq) was dissolved to 5 mM in MeOH and hydrodehalogenated by H-cube (10% Pd/C cartridge, 1 ml/min flow rate, 50 °C, 50 bar H_2). The product solution was concentrated, diluted with water, and lyophilized to give 2Am4CBza-L-16c. LC/MS [M+H] 403.23 (calculated); LC/MS [M+H] 403.56 (observed).

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-16d

2Am4CBza-L-16c was suspended in minimal TFA. After 15 minutes, the solution was concentrated to give 2Am4CBza-L-16d. LC/MS [M+H] 303.18 (calculated); LC/MS [M+H] 303.29 (observed).

Preparation of tert-butyl (39-(2-amino-3H-benzo[b]azepine-4-carbonyl)-34-oxo-3,6,9,12,15,18,21,24,27,30,38-undecaoxa-33,35,39-triazadotetracontyl)carbamate, 2Am4CBza-L-16e

To a solution of tert-butyl (32-amino-3,6,9,12,15,18,21,24,27,30-decaoxadotriacontyl)carbamate (0.143 g, 0.24 mmol, 1 eq) in DCM was added TEA (0.33 ml, 2.4 mmol, 10 eq), followed by phosgene (0.85 ml as 1.4 M solution in toluene, 0.24 mmol, 1 eq). The reaction mixture was monitored by LCMS, then 2Am4CBza-L-16d (0.072 g, 0.24 mmol, 1 eq) was added in one portion. The reaction mixture was monitored by LCMS, concentrated, and purified by reverse phase HPLC to give 2Am4CBza-L-16e, which was immediately carried forward. LC/MS [M+H] 929.54 (calculated); LC/MS [M+H] 929.84 (observed).

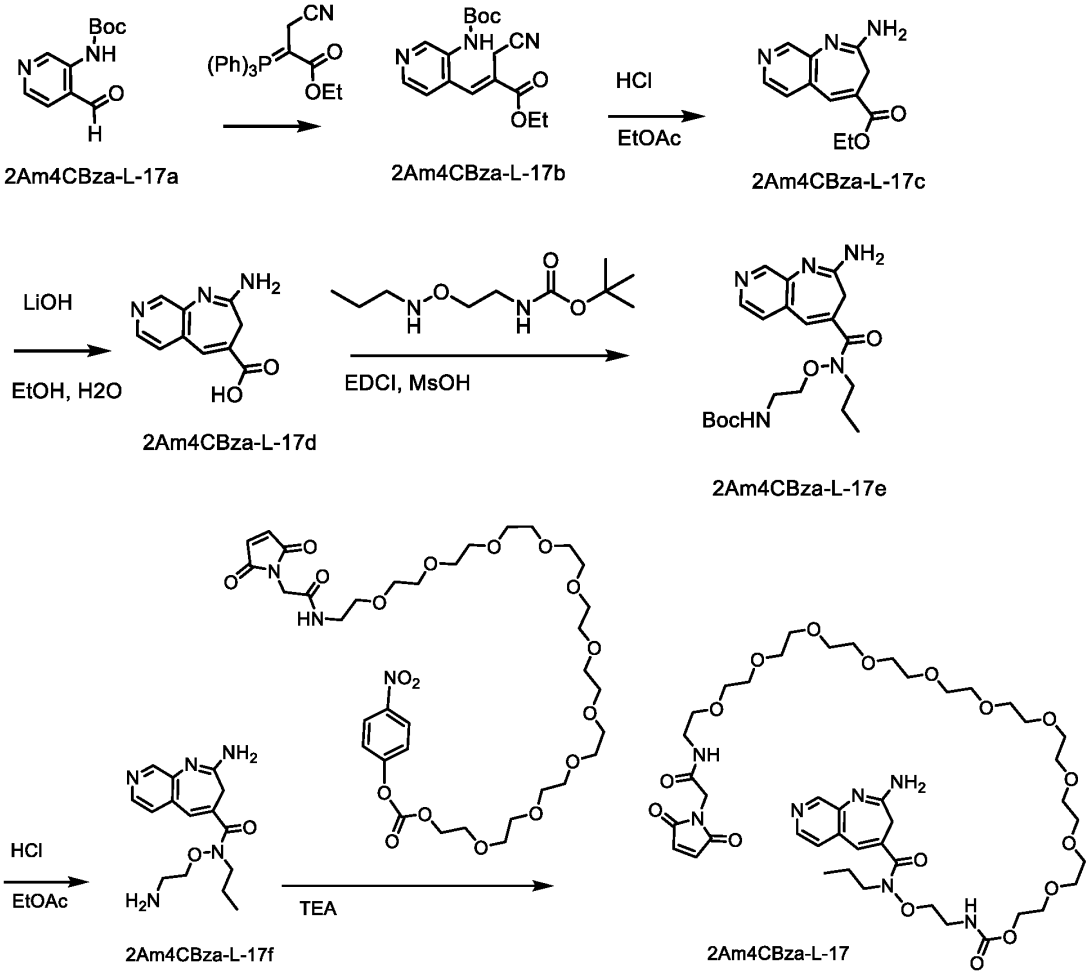
Preparation of 2-amino-N-((37-amino-4-oxo-8,11,14,17,20,23,26,29,32,35-decaoxa-3,5-diazaheptatriacontyl)oxy)-N-propyl-3H-benzo[b]azepine-4-carboxamide, 2Am4CBza-L-16f

2Am4CBza-L-16e was dissolved in minimal TFA. After 15 minutes, the solution was concentrated to give 2Am4CBza-L-16f (18.9 mg, 0.023 mmol, 10% over two steps). LC/MS [M+H] 829.49 (calculated); LC/MS [M+H] 829.73 (observed).

Preparation of 2Am4CBza-L-16

To a solution of 2Am4CBza-L-16f (18.9 mg, 0.023 mmol, 1 eq) in DMF (0.5 ml) was added TEA (0.032 ml, 0.23 mmol, 10 eq), followed by 2,5-dioxopyrrolidin-1-yl 2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)acetate (5.7 mg, 0.023 mmol, 1 eq). The reaction mixture was monitored by LCMS, concentrated, and purified by reverse phase HPLC to give 2Am4CBza-L-16 (11.3 mg, 0.023 mmol, 51%). LC/MS [M+H] 966.50 (calculated); LC/MS [M+H] 966.84 (observed).

Example 17 Synthesis of 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl)acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethyl N-[2-[(2-amino-3H-pyrido[3,4-b]azepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-17



2Am4CBza-L-17a 2Am4CBza-L-17b 2Am4CBza-L-17c

2Am4CBza-L-17d 2Am4CBza-L-17e

2Am4CBza-L-17f 2Am4CBza-L-17

Preparation of ethyl (E)-3-[3-(tert-butoxycarbonylamino)-4-pyridyl]-2-(cyanomethyl) prop-2-enoate, 2Am4CBza-L-17b

To a solution of tert-butyl N-(4-formyl-3-pyridyl)carbamate, 2Am4CBza-L-17a (500 mg, 2.25 mmol, 1.0 eq) in THF (5 mL) was added ethyl 3-cyano-2-(triphenyl-λ^5-phosphanylidene)propanoate (871 mg, 2.25 mmol, 1.0 eq). The mixture was stirred at 55 °C for 1 h. The reaction mixture was quenched by addition of H_2O (5 mL), and then extracted with EtOAc (20 mL x 3). The combined organic layers were washed with brine (5 mL x 3), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate = 1/0 to 0/1) to give 2Am4CBza-L-17b (2.8 g, crude) as yellow oil. LC/MS [M+H] 332.2 (calculated); LC/MS [M+H] 332.0 (observed).

Preparation of ethyl 2-amino-3H-pyrido[3,4-b]azepine-4-carboxylate, 2Am4CBza-L-17c

To a solution of 2Am4CBza-L-17b (2.6 g, 7.85 mmol, 1.0 eq) in EtOAc (1 mL) was added HCl/EtOAc (4 M, 20 mL, 10.2 eq). The mixture was stirred at 25°C for 12 h, then was stirred at 50°C for another 2 h. The reaction mixture was filtered. Then the filter cake was dried under reduced pressure to give a residue. Compound 2Am4CBza-L-17c (980 mg, 4.24 mmol, 54.0% yield) was obtained as yellow oil. ^{1}H NMR (400 MHz, DMSO-d_6) δ10.27 (s, 1H), 9.27 (s, 1H), 8.72 (s, 1H), 8.55 (d, J = 5.2 Hz, 1H), 7.88 (s, 1H), 7.74 (d, J = 5.2 Hz, 1H), 4.29 (q, J = 7.2 Hz, 2H), 3.57 (s, 2H), 1.32 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 232.1 (calculated); LC/MS [M+H] 232.2 (observed).

Preparation of 2-amino-3H-pyrido[3,4-b]azepine-4-carboxylic acid, 2Am4CBza-L-17d

To a solution of 2Am4CBza-L-17c (480 mg, 2.08 mmol, 1.0 eq) in H_2O (1 mL) and EtOH (5 mL) was added LiOH (149 mg, 6.23 mmol, 3.0 eq). The mixture was stirred at 50°C for 2 h. The reaction mixture was quenched with 2.5N HCl at 0°C until pH = 5-6, the result mixture was concentrated under reduced pressure to remove EtOH. The solid was filtered and the filter cake was dried under reduced pressure to give a residue. Compound 2Am4CBza-L-17d (250 mg, 1.23 mmol, 59.2% yield) was obtained as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ8.68 (s, 1H), 8.56 (d, J = 5.6 Hz, 1H), 7.86 (s, 1H), 7.79 (d, J = 5.6 Hz, 1H). LC/MS [M+H] 204.1 (calculated); LC/MS [M+H] 204.0 (observed).

Preparation of tert-butyl N-[2-[(2-amino-3H-pyrido[3,4-b]azepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-17e

To a solution of 2Am4CBza-L-17d (250 mg, 1.23 mmol, 1.0 eq) and tert-butyl N-[2-(propylaminooxy)ethyl]carbamate (537 mg, 2.46 mmol, 2.0 eq) in DCM (7.5 mL) and DMA (1.5 mL) was added MsOH (236 mg, 2.46 mmol, 175 uL, 2.0 eq) and EDCI (943 mg, 4.92 mmol, 4.0 eq). The mixture was stirred at 25°C for 2 h. The mixture was concentrated to remove DCM and the residue was diluted with water (30 mL). Then the pH of the aqueous phase was adjusted to 8-9 with aq.Na_2CO_3 at 0°C. Then extracted with EtOAc (10 ml x 3). The organic layer was washed with brine, dried over Na_2SO_4, filtered and concentrated. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate = 1/0 to 3/1) to give 2Am4CBza-L-17e (420 mg, 1.04 mmol, 84.6% yield) as a white solid. ^{1}H NMR (400 MHz, MeOD) δ8.37 (s, 1H), 8.08 (d, J = 5.2Hz, 1H), 7.37 (d, J = 5.4Hz, 1H), 7.20 (s, 1H), 4.61 (s, 1H), 3.91 (t, J = 5.2Hz, 2H), 3.72 (t, J = 7.2Hz, 2H), 3.23 (t, J = 5.2 Hz, 2H), 2.96 (s, 2H), 1.76 (sxt, J = 7.6Hz, 2H), 1.34 (s, 9H), 0.98 (t, J = 7.6Hz, 3H). LC/MS [M+H] 404.2 (calculated); LC/MS [M+H] 404.2 (observed).

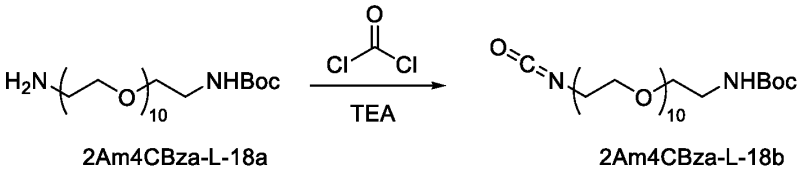
Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-3H-pyrido[3,4-b]azepine -4-carboxamide, 2Am4CBza-L-17f

To a solution of 2Am4CBza-L-17e (55 mg, 136 umol, 1.0 eq) in EtOAc (1 mL) was added HCl/EtOAc (4 M, 10 mL, 293.0 eq), and then stirred at 25°C for 1 h. The reaction mixture was concentrated under reduced pressure to give a residue. Compound 2Am4CBza-L-17f (51.2 mg, crude, 2HCl) was obtained as a white solid. LC/MS [M+H] 304.2 (calculated); LC/MS [M+H] 304.2 (observed).

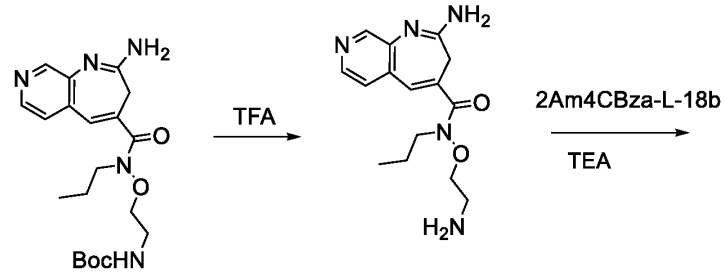
Preparation of 2Am4CBza-L-17

To a solution of 2Am4CBza-L-17f (50 mg, 94.1 umol, 1.0 eq , 2TFA) in DMF (1 mL) was added DIEA (60.8 mg, 470 umol, 81.9 uL 5.0 eq) and 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl)acetyl] amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethyl (4-nitrophenyl) carbonate (75.6 mg, 94.1 umol, 1.0 eq), and then stirred at 25 °C for 1 h. The mixture was quenched with TFA until pH = ~6. Then the mixture was filtered purified by prep-HPLC (column: Phenomenex Luna 80*30mm*3um;mobile phase: [water(TFA)-ACN];B%: 5%-35%,8min) to give 2Am4CBza-L-17 (40 mg, 41.3 umol, 43.9% yield) as yellow oil. ^{1}H NMR (400 MHz, MeOD -d_4) δ8.68 (s, 1H), 8.54 (d, J = 5.6Hz, 1H), 7.63 (d, J = 5.2Hz, 1H), 7.38 (s, 1H), 6.89 (s, 2H), 4.17 (s, 2H), 3.97 (t, J = 4.8 Hz, 2H), 3.89-3.81 (m, 2H), 3.75 (t, J = 7.2Hz, 2H), 3.71-3.57 (m, 38H), 3.54 (t, J = 5.6Hz, 2H), 3.52-3.48 (m, 2H), 3.45 (s, 2H), 3.38 (q, J = 5.2Hz, 2H), 1.85-1.73 (m, 2H), 1.00 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 968.5 (calculated); LC/MS [M+H] 968.5 (observed).

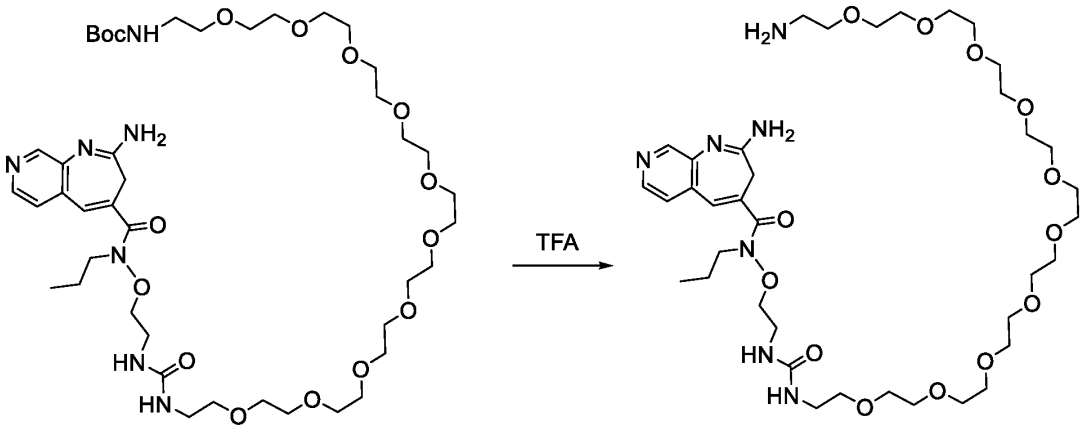
Example 18 Synthesis of 2-amino-N-((40-(2,5-dimethylene-2,5-dihydro-1H-pyrrol-1-yl)-4,39-dioxo-8,11,14,17,20,23,26,29,32,35-decaoxa-3,5,38-triazatetracontyl)oxy)-N-propyl-3H-pyrido[3,4-b]azepine-4-carboxamide, 2Am4CBza-L-18



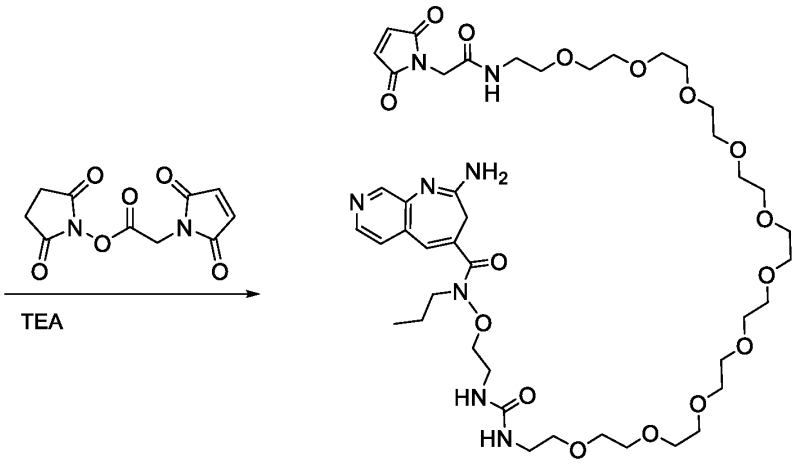
2Am4CBza-L-18a 2Am4CBza-L-18b



2Am4CBza-L-18c 2Am4CBza-L-18d



2Am4CBza-L-18e 2Am4CBza-L-18f



2Am4CBza-L-18

Preparation of tert-butyl (32-isocyanato-3,6,9,12,15,18,21,24,27,30-decaoxadotriacontyl)carbamate, 2Am4CBza-L-18b

To a solution of tert-butyl (32-amino-3,6,9,12,15,18,21,24,27,30-decaoxadotriacontyl)carbamate, 2Am4CBza-L-18a (0.15 g, 0.25 mmol, 1 eq) in DCM was added TEA (0.348 ml, 2.5 mmol, 10 eq), followed by phosgene (0.892 ml as a 1.4 M solution in toluene, 0.25 mmol, 1 eq). The reaction mixture was monitored by LCMS, concentrated, and purified by reverse phase HPLC to give 2Am4CBza-L-18b (78 mg, 0.125 mmol, 50%). LC/MS [M+H] 627.37 (calculated); LC/MS [M+H] 627.64 (observed).

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-3H-pyrido[3,4-b]azepine-4-carboxamide, 2Am4CBza-L-18d

tert-Butyl (2-((2-amino-N-propyl-3H-pyrido[3,4-b]azepine-4-carboxamido)oxy)ethyl)carbamate, 2Am4CBza-L-18c (6.1 mg, 0.015 mmol, 1 eq) was suspended in minimal TFA. After 15 minutes, the reaction mixture was concentrated to give

crude , 2Am4CBza-L-18d (12.7 mg, 0.031 mmol, 100%). LC/MS [M+H] 304.18 (calculated); LC/MS [M+H] 304.28 (observed).

Preparation of tert-butyl (39-(2-amino-3H-pyrido[3,4-b]azepine-4-carbonyl)-34-oxo-3,6,9,12,15,18,21,24,27,30,38-undecaoxa-33,35,39-triazadotetracontyl)carbamate, 2Am4CBza-L-18e

To a mixture of 2Am4CBza-L-18d (37.8 mg, 0.124 mmol, 1 eq) and 2Am4CBza-L-18b (78 mg, 0.124 mmol, 1 eq) in DMF was added TEA (0.17 ml, 1.24 mmol, 10 eq). The reaction was stirred at room temperature, then diluted with water and purified by reverse phase HPLC to give 2Am4CBza-L-18e (48 mg, 0.052 mmol, 41%). LC/MS [M+H] 930.54 (calculated); LC/MS [M+H] 930.54 (observed).

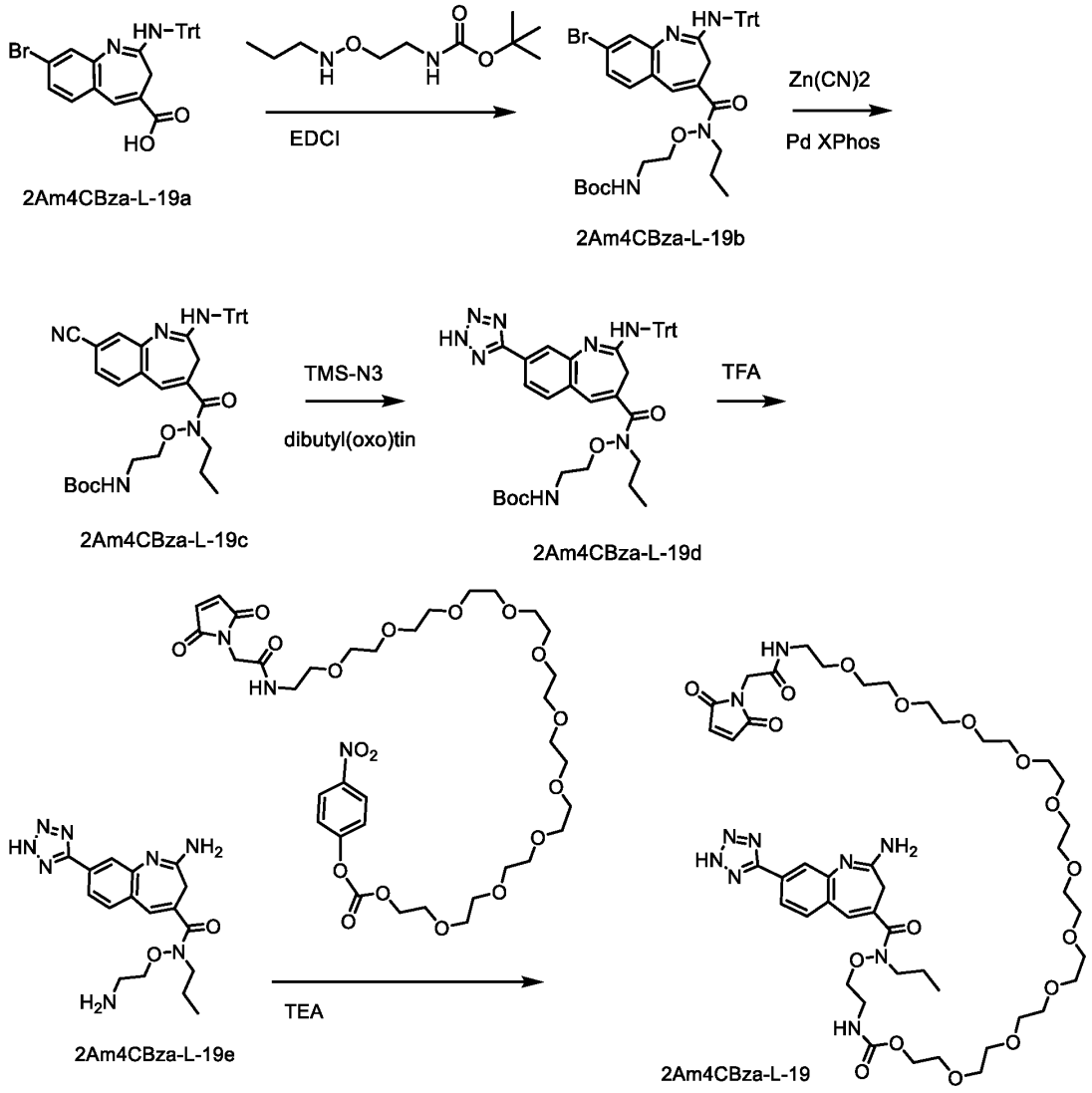
Preparation of 2-amino-N-((37-amino-4-oxo-8,11,14,17,20,23,26,29,32,35-decaoxa-3,5-diazaheptatriacontyl)oxy)-N-propyl-3H-pyrido[3,4-b]azepine-4-carboxamide, 2Am4CBza-L-18f

2Am4CBza-L-18e (48 mg, 0.052 mmol, 1 eq) was dissolved in minimal TFA. After 15 minutes, the reaction mixture was concentrated to give 2Am4CBza-L-18f as a TFA salt (0.053 g, 0.050 mmol, 96%). LC/MS [M+H] 830.49 (calculated); LC/MS [M+H] 830.76 (observed).

Preparation of 2Am4CBza-L-18

To a solution of 2Am4CBza-L-18f (0.053 g, 0.050 mmol, 1 eq) in DMF (0.5 ml) was added TEA (0.09 ml, 0.64 mmol, 12.8 eq) followed by 2,5-dioxopyrrolidin-1-yl 2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)acetate (0.016 g, 0.064 mmol, 1.28 eq). The reaction mixture was concentrated, diluted with 1% TFA in water, and purified by reverse phase HPLC to give 2Am4CBza-L-18 (38.5 mg, 0.040 mmol, 80%). LC/MS [M+H] 967.50 (calculated); LC/MS [M+H] 967.80 (observed).

Example 19 Synthesis of 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl)acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]eth yl N-[2-[[2-amino-8-(2H-tetrazol-5-yl)-3H-1-benzazepine-4-carbonyl]-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-19



Preparation of tert-butyl N-[2-[[8-bromo-2-(tritylamino)-3H-1-benzazepine-4-carbonyl] -propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-19b

A mixture of 8-bromo-2-(tritylamino)-3H-1-benzazepine-4-carboxylic acid, 2Am4CBza-L-19a (1.6 g, 3.06 mmol, 1.0 *eq*), tert-butyl N-[2-(propylaminooxy)ethyl]carbamate (800 mg, 3.67 mmol, 1.2 *eq*), methanesulfonic acid (293 mg, 3.06 mmol, 217 uL, 1.0 *eq*), EDCI (2.34 g, 12.2 mmol, 4.0 *eq*) in DCM (10 mL) and DMA (10 mL) was degassed and purged with N_2 for 3 times, and then stirred at 25°C for 1 h under N_2 atmosphere. The reaction mixture was quenched by addition H_2O (20 mL) and extracted with DCM (30 mL x 2). The combined organic layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate = 100:0 to 70:30) to give 2Am4CBza-L-19b (1.8 g, 2.49 mmol, 81.3% yield) as yellow oil. LC/MS [M+H] 725.3/723.3 (calculated); LC/MS [M+H] 725.3/723.3 (observed).

Preparation of tert-butyl N-[2-[[8-cyano-2-(tritylamino)-3H-1-benzazepine-4-carbonyl] -propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-19c

A mixture of 2Am4CBza-L-19b (0.8 g, 1.11 mmol, 1.0 eq), [2-(2-aminophenyl)phenyl]-chloro-palladium;dicyclohexyl-[3-(2,4,6-triisopropylphenyl)phenyl] phosphane (86.9 mg, 110 umol, 0.1 eq) and dicyclohexyl-[2-(2,4,6-triisopropylphenyl)phenyl]phosphane, XPhos (105 mg, 221 umol, 0.2 eq) in DMF (10 mL) was added $Zn(CN)_2$ (259 mg, 2.21 mmol, 140 uL, 2 eq) at 20°C and purged with N_2 for 3 times. The mixture was stirred at 120°C for 3 h under N_2 atmosphere. The reaction mixture was quenched by addition H_2O (20 mL), and extracted with EtOAc (20 mL*3). The combined organic layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 9:1 to 0:100) to give 2Am4CBza-L-19c (0.5 g, 746 umol, 67.5% yield) as a yellow solid. LC/MS [M+H] 670.3 (calculated); LC/MS [M+H] 670.4 (observed).

Preparation of tert-butyl N-[2-[propyl-[8-(2H-tetrazol-5-yl)-2-(tritylamino)-3H-1-benzazepine-4-carbonyl]amino]oxyethyl]carbamate, 2Am4CBza-L-19d

A mixture of 2Am4CBza-L-19c (0.5 g, 746 umol, 1.0 *eq*), trimethylsilylazide, TMS-N_3 (430 mg, 3.73 mmol, 490 uL, 5.0 *eq*), dibutyl(oxo)tin (55.7 mg, 223 umol, 0.3 *eq*) in toluene (8 mL) was degassed and purged with N_2 for 3 times at 25°C, and then stirred at 110°C for 16 h under N_2 atmosphere. The reaction mixture was quenched by addition H_2O (10 mL) at 25°C, and then extracted with EtOAc (20 mL x 3). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate = 100:1 to 1:1) to give 2Am4CBza-L-19d (0.22 g, 308 umol, 41.3% yield) as a yellow solid. LC/MS [M+H] 713.4 (calculated); LC/MS [M+H] 713.6 (observed).

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-8-(2H-tetrazol-5-yl)-3H-1-benzazepine-4-carboxamide, 2Am4CBza-L-19e

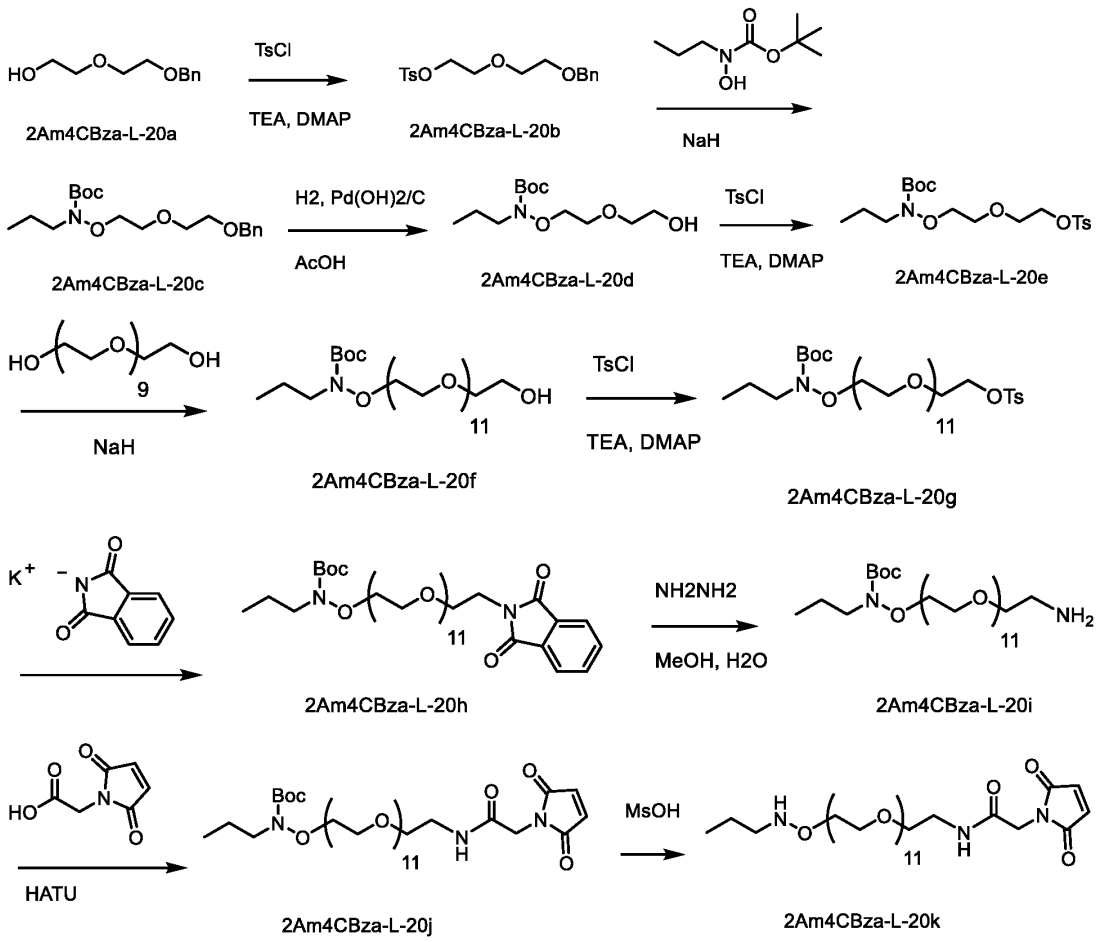
A mixture of 2Am4CBza-L-19d (20 mg, 28.0 umol, 1.0 *eq*), TFA (127 mg, 1.12 mmol, 83.0 uL, 40.0 *eq*), Et_3SiH (16.3 mg, 140 umol, 22.4 uL, 5.0 *eq*) in DCM (0.1 mL) was stirred at 40°C for 16 hr. The reaction mixture was concentrated under reduced pressure to give a residue. The crude product 2Am4CBza-L-19e (10 mg, 27.0 umol, 96.2% yield) was obtained as yellow oil. LC/MS [M+H] 371.2 (calculated); LC/MS [M+H] 371.2 (observed).

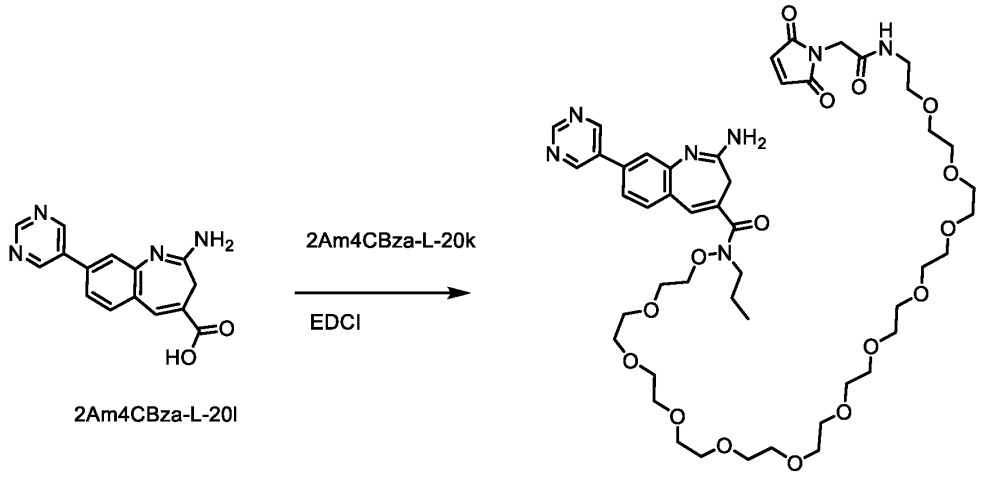
Preparation of 2Am4CBza-L-19

A mixture of 2Am4CBza-L-19e (30 mg, 80.9 umol, 1.0 *eq*), 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5- dioxopyrrol-1-yl)acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]eth

yl (4-nitrophenyl) carbonate (65.1 mg, 80.9 umol, 1.0 *eq*), TEA (40.9 mg, 404 umol, 56.3 uL, 5.0 *eq*) in DMF (1 mL) was degassed and purged with N_2 for 3 times, and then stirred at 0°C for 1 hr under N_2 atmosphere. The reaction solution was quenched by added TFA until pH = 5-6. The residue was purified by prep-HPLC (column: Phenomenex Luna 80 x 30mm x 3um;mobile phase: [water(TFA)-ACN];B%: 15%-40%,8min) to give 2Am4CBza-L-19 (5.2 mg, 4.92 umol, 6.08% yield, 98.0% purity) as a white solid. ^{1}H NMR (MeOD-d_4, 400 MHz) δ8.18 (s, 1H), 8.07 (t, J = 7.2 Hz, 1H),7.83 (d, J = 8.4 Hz, 1H), 6.90 (s, 1H), 4.18 (s, 2H), 4.01 (t, J = 4.0 Hz, 2H), 4.00 (t, J = 4.0 Hz, 2H), 3.85 (t, J = 4.0 Hz, 2H), 3.78-3.55 (m, 38H), 3.50-3.42 (m, 4H), 3.37 (m, 2H), 1.80 (m, 2H), 1.02 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 1035.5 (calculated); LC/MS [M+H] 1035.8 (observed).

Example 20 Synthesis of 2-amino-N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl) acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]-N-propyl-8-pyrimidin-5-yl-3H-1-benzazepine-4-carboxamide, 2Am4CBza-L-20





Preparation of 2-(2-benzyloxyethoxy)ethyl 4-methylbenzenesulfonate, 2Am4CBza-L-20b

To a solution of 2-(2-benzyloxyethoxy)ethanol, 2Am4CBza-L-20a (10 g, 51.0 mmol, 1.0 *eq*) in DCM (100 mL) was added TEA (15.5 g, 153 mmol, 21.3 mL, 3.0 *eq*), DMAP (1.25 g, 10.2 mmol, 0.2 *eq*) and p-toluenesulfonyl chloride, TosCl (14.6 g, 76.4 mmol, 1.5 *eq*) at 0°C. The mixture was stirred at 25°C for 12 hr. The reaction mixture was quenched by addition of H_2O (100 mL) at 0°C, and then extracted with DCM (50 mL x 3). The combined organic layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 1:0 to 1:1) to give 2Am4CBza-L-20b as a light yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ7.80 (d, J = 8.0 Hz, 2H), 7.39-7.27 (m, 7H), 4.54 (s, 2H), 4.22-4.14 (m, 2H), 3.74-3.68 (m, 2H), 3.65-3.54 (m, 4H), 2.44 (s, 3H), 1.58 (s, 9H).

Preparation of tert-butyl N-[2-(2-benzyloxyethoxy)ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20c

To a solution of 2Am4CBza-L-20b (5.5 g, 31.4 mmol, 1 *eq*) in THF (100 mL) was added sodium hydride, NaH (1.51 g, 37.7 mmol, 60% purity, 1.2 *eq*) at 0°C. After addition, the mixture was stirred at this temperature for 30 min, and then 2-(2-benzyloxyethoxy)ethyl 4-methylbenzenesulfonate (11.6 g, 33.0 mmol, 1.05 *eq*) was added at 0°C. The resulting mixture was stirred at 25°C for 30 min, then stirred at 50°C for another 1 hr. The reaction mixture was quenched by addition of NH_4Cl (100 mL) at 0°C, and then extracted with EtOAc (100 mL x 3). The combined organic layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate=1:0 to 3:1) to give 2Am4CBza-L-20c (6.6 g, 18.7 mmol, 59.5% yield) as a light yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ7.37-7.32 (m,

4H), 7.33-7.28 (m, 1H), 4.58 (s, 2H), 4.08-3.99 (m, 2H), 3.70 (dd, J = 4.8, 9.2 Hz, 4H), 3.67-3.60 (m, 2H), 3.46-3.37 (m, 2H), 1.70-1.61 (m, 2H), 1.49 (s, 9H), 0.90 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 354.3 (calculated); LC/MS [M+H] 354.3 (observed).

Preparation of tert-butyl N-[2-(2-hydroxyethoxy)ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20d

To a solution of 2Am4CBza-L-20c (6.6 g, 18.7 mmol, 1.0 *eq*) in MeOH (120 mL) was added $Pd(OH)_2/C$ (20%, 1 g) and AcOH (3.36 g, 56.0 mmol, 3.20 mL, 3.0 *eq*) under N_2. The suspension was degassed under vacuum and purged with H_2 several times. The mixture was stirred under H_2 (50 psi) at 25°C for 12 hr. The reaction mixture was filtered and concentrated under reduced pressure to give a residue. The residue was diluted with H_2O (50 mL) and adjusted pH to 8-9 with aq. Na_2CO_3 at 0°C and the aqueous phase was extracted with EtOAc (30 mL x 3). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give 2Am4CBza-L-20d (4.5 g, 17.1 mmol, 91.5% yield) as a light yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ4.06-3.98 (m, 2H), 3.80-3.67 (m, 4H), 3.66-3.59 (m, 2H), 3.45-3.37 (m, 2H), 1.71-1.62 (m, 2H), 1.50 (s, 9H), 0.92 (t, J = 7.6 Hz, 3H)

Preparation of 2-[2-[tert-butoxycarbonyl(propyl)amino]oxyethoxy]ethyl 4-methylbenzenesulfonate, 2Am4CBza-L-20e

To a solution of 2Am4CBza-L-20d (2.5 g, 9.49 mmol, 1.0 *eq*) in DCM (15 mL) was added TEA (2.88 g, 28.5 mmol, 3.96 mL, 3.0 *eq*), DMAP (232 mg, 1.90 mmol, 0.2 *eq*) and TosCl (2.71 g, 14.2 mmol, 1.5 *eq*) at 0°C. The mixture was stirred at 25°C for 12 hr. The reaction mixture was quenched by addition of H_2O (20 mL) at 0°C, and then extracted with DCM (10 mL x 3). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 1:0 to 3:1) to give 2Am4CBza-L-20e (3.27 g, 7.83 mmol, 82.5% yield) as a light yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ7.81 (d, J = 8.4 Hz, 2H), 7.35 (d, J = 8.0 Hz, 2H), 4.22-4.13 (m, 2H), 3.98-3.92 (m, 2H), 3.74-3.68 (m, 2H), 3.65-3.61 (m, 2H), 3.42-3.35 (m, 2H), 2.46 (s, 3H), 1.68-1.61 (m, 2H), 1.48 (s, 9H), 0.90 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 418.2 (calculated); LC/MS [M+Na] 440.2 (observed).

Preparation of tert-butyl N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-(2-hydroxyethoxy)ethoxy] ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20f

To a solution of 2-[2-[2-[2-[2-[2-[2-[2-[2-(2-hydroxyethoxy)ethoxy]ethoxy]ethoxy]ethoxy] ethoxy]ethoxy]ethoxy]ethoxy]ethanol (10.8 g,

23.5 mmol, 3.0 *eq*) in THF (100 mL) was added NaH (470 mg, 11.8 mmol, 60% purity, 1.5 *eq*) at 0°C. After addition, the mixture was stirred at this temperature for 15 min, and then 2Am4CBza-L-20e (3.27 g, 7.83 mmol, 1.0 *eq*) was added at 0°C. The resulting mixture was stirred at 25°C for 45 min. Then stirred at 50°C for another 4 hr. The reaction mixture was quenched by addition of NH_4Cl (100 mL) at 0°C, and then extracted EtOAc (50 mL x 3). The combined organic layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 1:0 to 0:1) and then (SiO_2, EtOAc:MeOH = 1:0 to 1:1) to give 2Am4CBza-L-20f (1.7 g, 2.42 mmol, 30.8% yield) was obtained as a light yellow oil. ^1H NMR (MeOD, 400 MHz) δ4.00-3.97 (m, 2H), 3.70-3.61 (m, 44H), 3.58-3.54 (m, 2H), 3.47-3.41 (m, 2H), 1.64 (t, J = 7.2 Hz, 2H), 1.49 (s, 9H), 0.91 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 703.4 (calculated); LC/MS [M+Na] 726.4 (observed).

Preparation of 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[tert-butoxycarbonyl(propyl)amino] oxyethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethyl 4-methylbenzenesulfonate, 2Am4CBza-L-20g

To a solution of 2Am4CBza-L-20f (1.7 g, 2.42 mmol, 1.0 *eq*) in DCM (30 mL) was added DMAP (118 mg, 966 umol, 0.4 *eq*), TEA (978 mg, 9.66 mmol, 1.34 mL, 4.0 *eq*) and TosCl (921 mg, 4.83 mmol, 2.0 *eq*) at 0°C. The resulting mixture was stirred at 25°C for 12 hr. The reaction mixture was quenched by addition of H_2O (30 mL) at 0°C, and then extracted with DCM (30 mL x **3**). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 1:0 to 0:1) and then (SiO_2, EtOAc:MeOH = 1:0 to 1:1) to give 2Am4CBza-L-20g (2.0 g, 2.33 mmol, 96.5% yield) as a light yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ7.81 (d, J = 8.2 Hz, 2H), 7.35 (d, J = 8.0 Hz, 2H), 4.20-4.13 (m, 2H), 4.04-3.98 (m, 2H), 3.71-3.58 (m, 46H), 3.45-3.38 (m, 2H), 2.46 (s, 3H), 1.70-1.63 (m, 2H), 1.49 (s, 9H), 0.91 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 858.4 (calculated); LC/MS [M+Na] 880.5 (observed).

Preparation of tert-butyl N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-(1,3-dioxoisoindolin-2-yl) ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20h

To a solution of 2Am4CBza-L-20g (2.0 g, 2.33 mmol, 1.0 *eq*) in DMF (20 mL) was added (1,3-dioxoisoindolin-2-yl)potassium (648 mg, 3.50 mmol, 1.5 *eq*). The mixture was stirred at 50°C for 12 hr. The reaction mixture was quenched by addition of H_2O (60 mL) at 0°C, and then extracted with EtOAc (30 mL x 3). The combined organic layers were washed with brine (10 mL x 3), dried over Na_2SO_4, filtered and concentrated under reduced pressure to

give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether Ethyl acetate = 1:0 to 0:1) and then (SiO_2, EtOAc:MeOH = 1:0 to 10:1) to give 2Am4CBza-L-20h (1.47 g, 1.76 mmol, 75.7% yield) as a light yellow oil. ^{1}H NMR ($CDCl_3$, 400 MHz) δ7.85 (dd, J = 3.2, 5.6 Hz, 2H), 7.72 (dd, J = 3.2, 5.6 Hz, 2H), 4.03-3.99 (m, 2H), 3.93-3.88 (m, 2H), 3.77-3.72 (m, 2H), 3.71-3.57 (m, 42H), 3.44-3.38 (m, 2H), 1.70-1.64 (m, 2H), 1.49 (s, 9H), 0.91 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 833.4 (calculated); LC/MS [M+H_2O] 850.5 (observed).

Preparation of tert-butyl N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-(2-aminoethoxy)ethoxy] ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20i

To a solution of 2Am4CBza-L-20h (1.0 g, 1.20 mmol, 1.0 *eq*) in MeOH (15 mL) was added $NH_2NH_2.H_2O$ (1.21 g, 23.7 mmol, 1.17 mL, 98% purity, 19.7 *eq*). The mixture was stirred at 50°C for 6 hr. The reaction mixture was cooled to 25°C, filtered and concentrated under reduced pressure to give a residue. The crude product was triturated with MTBE (20 mL) at 0°C for 30 min, filtered and the filtrate was concentrated under reduced pressure to give 2Am4CBza-L-20i (0.92 g, crude) was obtained as light yellow oil. ^{1}H NMR (MeOD, 400 MHz) δ4.02-3.95 (m, 2H), 3.68-3.61 (s, 40H), 3.55 (t, J = 5.2 Hz, 2H), 3.48-3.40 (m, 2H), 2.83 (t, J = 5.2 Hz, 2H), 1.64 (t, J = 7.2 Hz, 2H), 1.49 (s, 9H), 0.91 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 703.6 (calculated); LC/MS [M+H] 703.6 (observed).

Preparation of tert-butyl N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl) acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]-N-propyl-carbamate, 2Am4CBza-L-20j

To a solution of 2Am4CBza-L-20i (0.77 g, 1.10 mmol, 1.0 *eq*) and 2-(2,5-dioxopyrrol-1-yl)acetic acid (255 mg, 1.64 mmol, 1.5 *eq*) in DCM (20 mL) was added TEA (333 mg, 3.29 mmol, 457 uL, 3 .0*eq*) and HATU (417 mg, 1.10 mmol, 1.0 *eq*) at 0°C. The mixture was stirred at 25°C for 0.5 hr. The pH of the reaction mixture was adjusted to 5-6 with TFA at 0°C, and then diluted with H_2O (20 mL) and extracted with DCM (20 mL x 3). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether:Ethyl acetate = 1:0 to 0:1) and then (SiO_2, EtOAc:MeOH = 1:0 to 10:1) to give 2Am4CBza-L-20j (0.63 g, 750 umol, 68.5% yield) as light yellow oil. ^{1}H NMR (MeOD, 400 MHz) δ6.90 (s, 2H), 4.17 (s, 2H), 4.02-3.96 (m, 2H), 3.68-3.61 (m, 42H), 3.55 (t, J = 5.6 Hz, 2H), 3.47-3.42 (m, 2H), 3.40-3.35 (m, 2H), 1.64 (sxt, J = 7.2 Hz, 2H), 1.49 (s, 9H), 0.91 (t, J = 7.6 Hz, 3H). LC/MS [M+H] 840.5 (calculated); LC/MS [M+H] 840.5 (observed).

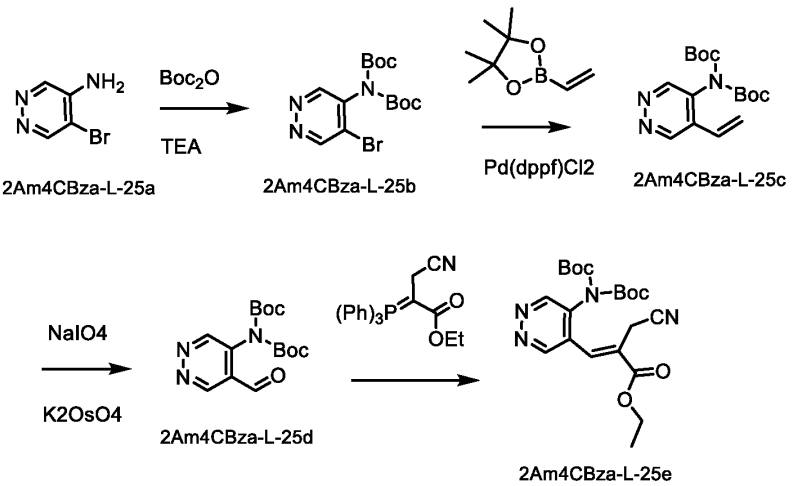
Preparation of 2-(2,5-dioxopyrrol-1-yl)-N-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[2-(propylaminooxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethyl]acetamide, 2Am4CBza-L-20k

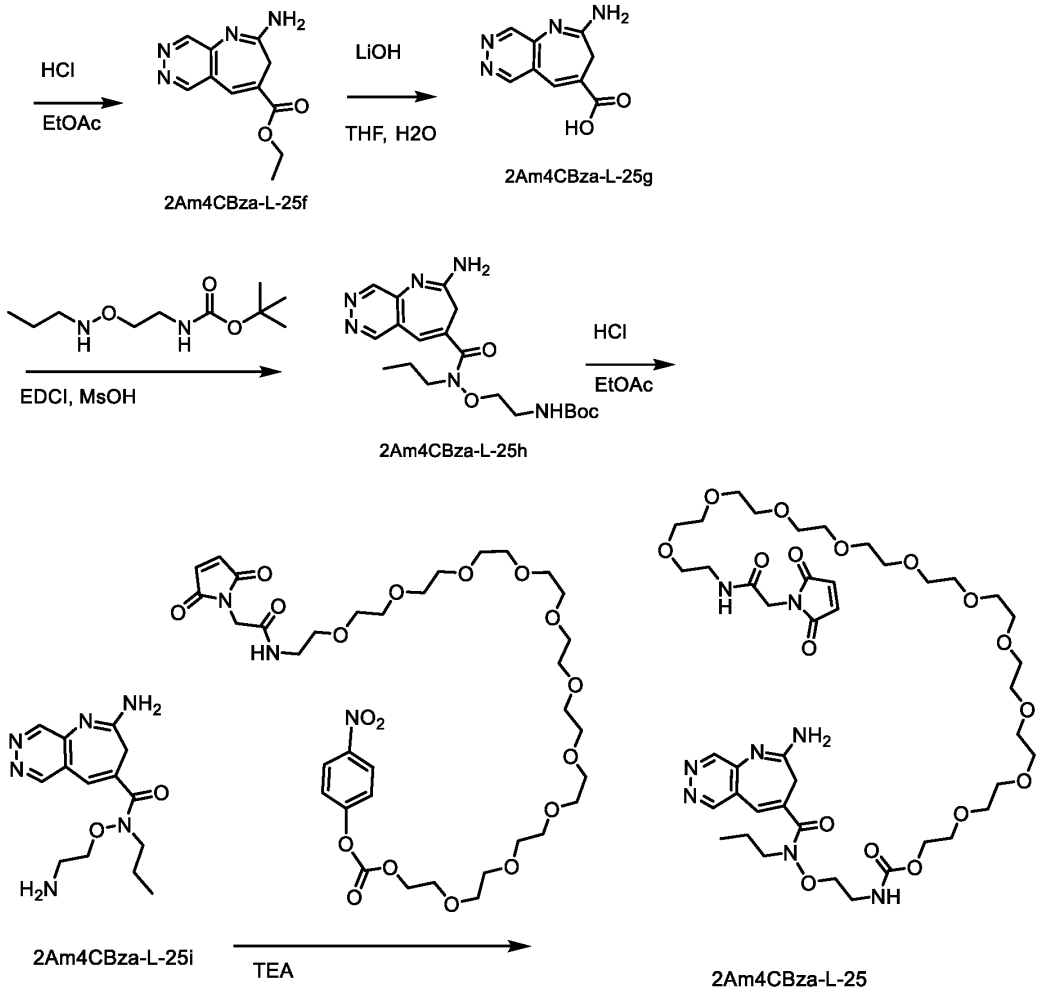
To a solution of 2Am4CBza-L-20j (300 mg, 357 umol, 1.0 *eq*) in DCM (6 mL) was added methanesulfonic acid, MsOH (103 mg, 1.07 mmol, 76.3 uL, 3.0 *eq*). The mixture was stirred at 25°C for 1 hr. The reaction was without workup and used for next step. Compound 2Am4CBza-L-20k (0.3 g, crude, MsOH) was obtained as light yellow oil. LC/MS [M+H] 740.5 (calculated); LC/MS [M+H] 740.5 (observed).

Preparation of 2Am4CBza-L-20

To a solution of 2Am4CBza-L-20k (150 mg, 179 umol, 1.0 *eq*, MsOH) and 2-amino-8-pyrimidin-5-yl-3H-1-benzazepine-4-carboxylic acid, 2Am4CBza-L-20l (70.8 mg, 179 umol, 1.0 *eq*, TFA) in DMA (1 mL) and DCM (3 mL) was added EDCI (138 mg, 718 umol, 4.0 *eq*). The mixture was stirred at 25°C for 0.5 hr. The reaction mixture was concentrated under reduced pressure to remove DCM, and filtered. The residue was purified by prep-HPLC (TFA condition; column: Phenomenex Luna 80 x 30mm x 3um;mobile phase: [water(TFA)-ACN];B%: 15%-40%,8min) to give 2Am4CBza-L-20 (35.3 mg, 31.6 umol, 17.6% yield, TFA) as light yellow oil. ^{1}H NMR (MeOD, 400 MHz) δ9.22 (s, 1H), 9.17 (s, 2H), 7.85-7.79 (m, 2H), 7.78-7.74 (m, 1H), 7.42 (s, 1H), 6.89 (s, 2H), 4.16 (s, 2H), 4.09-4.04 (m, 2H), 3.77 (t, J = 7.2 Hz, 2H), 3.68-3.52 (m, 40H), 3.47-3.40 (m, 4H), 3.39-3.34 (m, 2H), 3.28-3.23 (m, 2H), 1.79 (sxt, J = 7.2 Hz, 2H), 1.02 (t, J = 7.2 Hz, 3H). LC/MS [M+H] 1002.5 (calculated); LC/MS [M+H] 1002.5 (observed).

Example 25 Synthesis of 2-[2-[2-[2-[2-[2-[2-[2-[2-[2-[[2-(2,5-dioxopyrrol-1-yl)acetyl]amino]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethyl N-[2-[(2-amino-3H-pyridazino[4,5-b]azepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-25





Preparation of tert-butyl N-(5-bromopyridazin-4-yl)-N-tert-butoxycarbonyl-carbamate, 2Am4CBza-L-25b

To a solution of 5-bromopyridazin-4-amine, 2Am4CBza-L-25a (2 g, 11.5 mmol, 1 eq) in THF (20 mL) was added Et_3N (2.33 g, 23.0 mmol, 3.20 mL, 2 eq) Boc_2O (3.26 g, 14.9 mmol, 3.43 mL, 1.3 eq) and DMAP (140 mg, 1.15 mmol, 0.1 eq) at 0°C, and then stirred at 25°C for 1hr. The reaction mixture was quenched by addition of H_2O (10 mL), and extracted with EtOAc (10mL x 3). The combined organic layers were dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate=1/0 to 0/1) to give 2Am4CBza-L-25b (0.88 g, 2.35 mmol, 20.46% yield) as a white solid.

Preparation of tert-butyl N-tert-butoxycarbonyl-N-(5-vinylpyridazin-4-yl)carbamate, 2Am4CBza-L-25c

To a solution of 2Am4CBza-L-25b (0.88 g, 2.35 mmol, 1 eq) in dioxane (12 mL) and H_2O (3 mL) was added 4,4,5,5-tetramethyl-2-vinyl-1,3,2-dioxaborolane (470 mg, 3.06 mmol,

518 uL, 1.3 eq) and K_2CO_3 (650 mg, 4.70 mmol, 2 eq) and $Pd(dppf)Cl_2$ (172 mg, 235 umol, 0.1 eq) at 25°C under N_2. The mixture was stirred at 90°C for 2 hr. The reaction mixture was quenched by addition H_2O (20 mL) and extracted with EtOAc (20mL x 3). The combined organic layers were dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate=1/0 to 1/1) to give 2Am4CBza-L-25c (1.12 g, crude) as a yellow solid. LC/MS [M+H] 322.2 (calculated); LC/MS [M+H] 322.1 (observed).

Preparation of tert-butyl N-tert-butoxycarbonyl-N-(5-formylpyridazin-4-yl)carbamate, 2Am4CBza-L-25d

To a solution of 2Am4CBza-L-25c (1.12 g, 3.49 mmol, 1 eq) in dioxane (30 mL) and H_2O (10 mL) was added sodium periodate, $NaIO_4$ (3.73 g, 17.4 mmol, 965 uL, 5 eq) and dipotassium osmium tetroxide, $K_2OsO4 \cdot 2H_2O$ (128.41 mg, 348.51 umol, 0.1 eq). The mixture was stirred at 0 °C for 1 hr. The reaction mixture was quenched by addition $Na_2S_2O_3$ (5 mL), and then diluted with H_2O (30 mL) and extracted with EtOAc (30 mL x 3). The combined organic layers were dried over $NaSO_4$, filtered and concentrated under reduced pressure to give a residue. The residue was purified by column chromatography (SiO_2, Petroleum ether/Ethyl acetate=1/0 to 1/1) to give 2Am4CBza-L-25d (940 mg, 2.91 mmol, 83.4% yield) as a white solid.

Preparation of ethyl (E)-3-[5-[bis(tert-butoxycarbonyl)amino]pyridazin-4-yl] -2-(cyanomethyl)prop-2-enoate, 2Am4CBza-L-25e

To a solution of 2Am4CBza-L-25d (0.940 g, 2.91 mmol, 1 *eq*) in DCM (15 mL) was added ethyl 3-cyano-2-(triphenyl-λ^5-phosphanylidene)propanoate (1.24 g, 3.20 mmol, 1.1 *eq*). The mixture was stirred at 30°C for 0.5 hr. The reaction mixture was concentrated under reduced pressure to give 2Am4CBza-L-25e (2.10 g, crude) as a yellow oil. LC/MS [M+H] 433.2 (calculated); LC/MS [M+H] 433.1 (observed).

Preparation of ethyl 2-amino-3H-pyridazino[4,5-b]azepine-4-carboxylate, 2Am4CBza-L-25f

To a solution of 2Am4CBza-L-25e (2.10 g, 4.86 mmol, 1 *eq*) in EtOAc (5 mL) was added HCl/EtOAc (4 M, 50 mL, 41.2 *eq*). The mixture was stirred at 25°C for 12 hr. The reaction mixture was filtered and the solid was dried under reduced pressure to give 2Am4CBza-L-25f (1.00 g, 4.31 mmol, 88.7% yield) as a light yellow solid. LC/MS [M+H] 233.1 (calculated); LC/MS [M+H] 233.2 (observed).

Preparation of 2-amino-3H-pyridazino[4,5-b]azepine-4-carboxylic acid, 2Am4CBza-L-25g

To a solution of 2Am4CBza-L-25f (1 g, 4.31 mmol, 1.0 eq) in THF (10 mL) and H_2O (2.5 mL) was added $LiOH.H_2O$ (452 mg, 10.8 mmol, 2.5 eq). The mixture was stirred at 25°C for 2 hr. The reaction mixture was concentrated under reduced pressure to remove THF. The pH of the aqueous phase was adjusted to 5~6 with HCl (2M) and then extracted with MTBE 15 mL (5 mL x 3). The combined organic layers were washed with brine (8 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give 2Am4CBza-L-25g (268 mg, 1.31 mmol, 30.5% yield) as a white solid. ^1H NMR (400 MHz, DMSO-d_6) δ8.94 (s, 1H), 8.74 (s, 1H), 7.96-7.78 (m, 2H), 7.74 (s, 1H), 3.01 (s, 2H). LC/MS [M+H] 205.1 (calculated); LC/MS [M+H] 205.0 (observed)

Preparation of tert-butyl N-[2-[(2-amino-3H-pyridazino[4,5-b]azepine-4-carbonyl)-propyl-amino]oxyethyl]carbamate, 2Am4CBza-L-25h

To a solution of 2Am4CBza-L-25g (240 mg, 1.18 mmol, 1.0 eq) in DMA (2 mL) and DCM (2 mL) was added methanesulfonic acid (113 mg, 1.18 mmol, 84.0 uL, 1.0 eq) , tert-butyl N-[2- (propylaminooxy)ethyl]carbamate (257 mg, 1.18 mmol, 1.0 eq) and EDCI (676 mg, 3.53 mmol, 3.0 eq). The mixture was stirred at 25°C for 30 min. The reaction mixture was diluted with H_2O (8 mL) and the pH of the result mixture was adjusted to 8-9 with $NaHCO_3$.aq, then extracted with EtOAc (150 mL x 2). The combined organic layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated under reduced pressure to give a residue. The residue was purified by flash silica gel chromatography (ISCO; 12g SepaFlash Silica Flash Column, Eluent of 0-100% Ethylacetate/Petroleum ether gradient, then 100-91%Ethylacetate/Methanol 35 mL/min) to give 2Am4CBza-L-25h (150 mg, 371 umol, 31.6% yield) as a light yellow solid. ^1H NMR (400 MHz, MeOD) δ8.91 (s, 1H), 8.78 (s, 1H), 7.29 (s, 1H), 3.90 (t, J = 5.2 Hz, 2H), 3.73 (t, J = 7.1 Hz, 2H), 3.23 (t, J = 5.1 Hz, 2H), 3.02 (s, 2H), 1.85-1.69 (m, 2H), 1.33 (s, 9H), 0.98 (t, J = 7.4 Hz, 3H). LC/MS [M+H] 405.2 (calculated); LC/MS [M+H] 405.2 (observed)

Preparation of 2-amino-N-(2-aminoethoxy)-N-propyl-3H-pyridazino[4,5-b]azepine-4-carboxamide, 2Am4CBza-L-25i

Prepared using the same procedure outlined in Example 17 for 2Am4CBza-L-17f. LC/MS [M+H] 305.17 (calculated); LC/MS [M+H] 305.30 (observed).

Preparation of 2Am4CBza-L-25

Prepared using the same procedure outlined in Example 17 for 2Am4CBza-L-17. LC/MS [M+H] 969.48 (calculated); LC/MS [M+H] 969.85 (observed).

Example 201 Preparation of Immunoconjugates (IC)

To prepare a lysine-conjugated Immunoconjugate, an antibody is buffer exchanged into a conjugation buffer containing 100 mM boric acid, 50 mM sodium chloride, 1 mM ethylenediaminetetraacetic acid at pH 8.3, using G-25 SEPHADEX™ desalting columns (Sigma-Aldrich, St. Louis, MO) or Zeba™ Spin Desalting Columns (Thermo Fisher Scientific). The eluates are then each adjusted to a concentration of about 1-10 mg/ml using the buffer and then sterile filtered. The antibody is pre-warmed to 20-30 °C and rapidly mixed with 2-20 (e.g., 7-10) molar equivalents of a tetrafluorophenyl (TFP) or sulfonic tetrafluorophenyl (sulfoTFP) ester, 2-amino-4-carboxamide-benzazepine-linker (2Am4CBza-L) compound of Formula II dissolved in dimethylsulfoxide (DMSO) or dimethylacetamide (DMA) to a concentration of 5 to 20 mM. The reaction is allowed to proceed for about 16 hours at 30 °C and the immunoconjugate (IC) is separated from reactants by running over two successive G-25 desalting columns or Zeba™ Spin Desalting Columns equilibrated in phosphate buffered saline (PBS) at pH 7.2 to provide the Immunoconjugate (IC) of Tables 3a and 3b. Adjuvant-antibody ratio (DAR) is determined by liquid chromatography mass spectrometry analysis using a C4 reverse phase column on an ACQUITY™ UPLC H-class (Waters Corporation, Milford, MA) connected to a XEVO™ G2-XS TOF mass spectrometer (Waters Corporation).

To prepare a cysteine-conjugated Immunoconjugate, an antibody is buffer exchanged into a conjugation buffer containing PBS, pH 7.2 with 2 mM EDTA using Zeba™ Spin Desalting Columns (Thermo Fisher Scientific). The interchain disulfides are reduced using 2–4 molar excess of Tris (2-carboxyethyl) phosphine (TCEP) or dithiothreitol (DTT) at 37 °C for 30 min – 2 hours. Excess TCEP or DTT was removed using a Zeba™ Spin Desalting column pre-equilibrated with the conjugation buffer. The concentration of the buffer-exchanged antibody was adjusted to approximately 5 to 20 mg/ml using the conjugation buffer and sterile-filtered. The maleimide-2Am4CBza-L compound is either dissolved in dimethylsulfoxide (DMSO) or dimethylacetamide (DMA) to a concentration of 5 to 20 mM. For conjugation, the antibody is mixed with 10 to 20 molar equivalents of maleimide-2Am4CBza-L. In some instances, additional DMA or DMSO up to 20% (v/v), was added to improve the solubility of the maleimide-2Am4CBza-L in the conjugation buffer. The reaction is allowed to proceed for approximately 30 min to 4 hours at 20 °C. The resulting conjugate is purified away from the unreacted maleimide-2Am4CBza-L using two successive Zeba™ Spin Desalting Columns. The columns are pre-equilibrated with phosphate-buffered saline (PBS), pH 7.2. Adjuvant to antibody ratio (DAR) is estimated by liquid chromatography mass spectrometry analysis using a C4 reverse phase column on an ACQUITY™ UPLC H-class (Waters Corporation, Milford, MA) connected to a XEVO™ G2-XS TOF mass spectrometer (Waters Corporation).

For conjugation, the antibody may be dissolved in an aqueous buffer system known in the art that will not adversely impact the stability or antigen-binding specificity of the antibody. Phosphate buffered saline may be used. The 2Am4CBza-L compound is dissolved in a solvent system comprising at least one polar aprotic solvent as described elsewhere herein. In some such aspects, 2Am4CBza-L is dissolved to a concentration of about 5 mM, about 10 mM, about 20 mM, about 30 mM, about 40 mM or about 50 mM, and ranges thereof such as from about 5 mM to about 50 mM or from about 10 mM to about 30 mM in pH 8 Tris buffer (e.g., 50 mM Tris). In some aspects, the 2-amino-4-carboxamide-benzazepine-linker intermediate is dissolved in DMSO (dimethylsulfoxide), DMA (dimethylacetamide), acetonitrile, or another suitable dipolar aprotic solvent.

Alternatively in the conjugation reaction, an equivalent excess of 2Am4CBza-L solution may be diluted and combined with antibody solution. The 2Am4CBza-L solution may suitably be diluted with at least one polar aprotic solvent and at least one polar protic solvent, examples of which include water, methanol, ethanol, n-propanol, and acetic acid. The molar equivalents of 2Am4CBza-L intermediate to antibody may be about 1.5:1, about 3:1, about 5:1, about 10:1, about 15:1, or about 20:1, and ranges thereof, such as from about 1.5:1 to about 20:1 from about 1.5:1 to about 15:1, from about 1.5:1 to about 10:1,from about 3:1 to about 15:1, from about 3:1 to about 10:1, from about 5:1 to about 15:1 or from about 5:1 to about 10:1. The reaction may suitably be monitored for completion by methods known in the art, such as LC-MS. The conjugation reaction is typically complete in a range from about 1 hour to about 16 hours. After the reaction is complete, a reagent may be added to the reaction mixture to quench the reaction. If antibody thiol groups are reacting with a thiol-reactive group such as maleimide of the 2Am4CBza-L linker intermediate, unreacted antibody thiol groups may be reacted with a capping reagent. An example of a suitable capping reagent is ethylmaleimide.

Following conjugation, the immunoconjugates may be purified and separated from unconjugated reactants and/or conjugate aggregates by purification methods known in the art such as, for example and not limited to, size exclusion chromatography, hydrophobic interaction chromatography, ion exchange chromatography, chromatofocusing, ultrafiltration, centrifugal ultrafiltration, tangential flow filtration, and combinations thereof. For instance, purification may be preceded by diluting the immunoconjugate, such in 20 mM sodium succinate, pH 5. The diluted solution is applied to a cation exchange column followed by washing with, e.g., at least 10 column volumes of 20 mM sodium succinate, pH 5. The conjugate may be suitably eluted with a buffer such as PBS.

Example 202 HEK Reporter Assay

HEK293 reporter cells expressing human TLR7 or human TLR8 were purchased from Invivogen and vendor protocols were followed for cellular propagation and experimentation. Briefly, cells were grown to 80-85% confluence at 5% CO_2 in DMEM supplemented with 10% FBS, Zeocin, and Blasticidin. Cells were then seeded in 96-well flat plates at $4x10^4$ cells/well with substrate containing HEK detection medium and immunostimulatory 2-amino-4-carboxamide-benzazepine compounds, such as those of Table 1. Activity was measured using a plate reader at 620-655 nm wavelength.

Example 203 Assessment of Immunoconjugate Activity *In Vitro*

This example shows that Immunoconjugates of the invention, including those of Tables 3a and 3b, are effective at eliciting immune activation, and therefore are useful for the treatment of cancer.

a) Isolation of Human Antigen Presenting Cells: Human myeloid antigen presenting cells (APCs) were negatively selected from human peripheral blood obtained from healthy blood donors (Stanford Blood Center, Palo Alto, California) by density gradient centrifugation using a ROSETTESEP™ Human Monocyte Enrichment Cocktail (Stem Cell Technologies, Vancouver, Canada) containing monoclonal antibodies against CD14, CD16, CD40, CD86, CD123, and HLA-DR. Immature APCs were subsequently purified to >90% purity via negative selection using an EASYSEP™ Human Monocyte Enrichment Kit (Stem Cell Technologies) without CD16 depletion containing monoclonal antibodies against CD14, CD16, CD40, CD86, CD123, and HLA-DR.

b) Myeloid APC Activation Assay: 2 x 10^5 APCs are incubated in 96-well plates (Corning, Corning, NY) containing iscove's modified dulbecco's medium, IMDM (Lonza) supplemented with 10% FBS, 100 U/mL penicillin, 100 µg/mL (micrograms per milliliter) streptomycin, 2 mM L-glutamine, sodium pyruvate, non-essential amino acids, and where indicated, various concentrations of unconjugated (naked) antibodies and immunoconjugates (IC) of the invention, including those of Tables 3a and 3b, (as prepared according to the Example above). Cell-free supernatants are analyzed after 18 hours via ELISA to measure TNFα secretion as a readout of a proinflammatory response.

c) PBMC Activation Assay: Human peripheral blood mononuclear cells were isolated from human peripheral blood obtained from healthy blood donors (Stanford Blood Center, Palo Alto, California) by density gradient centrifugation. PBMCs were incubated in 96-well plates (Corning, Corning, NY) in a co-culture with CEA-expressing tumor cells (e.g. MKN-45, HPAF-II) at a 10:1 effector to target cell ratio. Cells were stimulated with various

concentrations of unconjugated (naked) antibodies and immunoconjugates of the invention (as prepared according to the Example above). Cell-free supernatants were analyzed by cytokine bead array using a LegendPlex™ kit according to manufacturer's guidelines (BioLegend®, San Diego, CA).

d) Isolation of Human Conventional Dendritic Cells: Human conventional dendritic cells (cDCs) were negatively selected from human peripheral blood obtained from healthy blood donors (Stanford Blood Center, Palo Alto, California) by density gradient centrifugation. Briefly, cells are first enriched by using a ROSETTESEP™ Human CD3 Depletion Cocktail (Stem Cell Technologies, Vancouver, Canada) to remove T cells from the cell preparation. cDCs are then further enriched via negative selection using an EASYSEP™ Human Myeloid DC Enrichment Kit (Stem Cell Technologies).

e) cDC Activation Assay: 8×10^4 APCs were co-cultured with tumor cells expressing the ISAC target antigen at a 10:1 effector (cDC) to target (tumor cell) ratio. Cells were incubated in 96-well plates (Corning, Corning, NY) containing RPMI-1640 medium supplemented with 10% FBS, and where indicated, various concentrations of the indicated immunoconjugate of the invention (as prepared according to the example above). Following overnight incubation of about 18 hours, cell-free supernatants were collected and analyzed for cytokine secretion (including TNFα) using a BioLegend LEGENDPLEX cytokine bead array.

Activation of myeloid cell types can be measured using various screen assays in addition to the assay described in which different myeloid populations are utilized. These may include the following: monocytes isolated from healthy donor blood, M-CSF differentiated Macrophages, GM-CSF differentiated Macrophages, GM-CSF+IL-4 monocyte-derived Dendritic Cells, conventional Dendritic Cells (cDCs) isolated from healthy donor blood, and myeloid cells polarized to an immunosuppressive state (also referred to as myeloid derived suppressor cells or MDSCs). Examples of MDSC polarized cells include monocytes differentiated toward immunosuppressive state such as M2a MΦ (IL4/IL13), M2c MΦ (IL10/TGFb), GM-CSF/IL6 MDSCs and tumor-educated monocytes (TEM). TEM differentiation can be performed using tumor-conditioned media (e.g. 786.O, MDA-MB-231, HCC1954). Primary tumor-associated myeloid cells may also include primary cells present in dissociated tumor cell suspensions (Discovery Life Sciences).

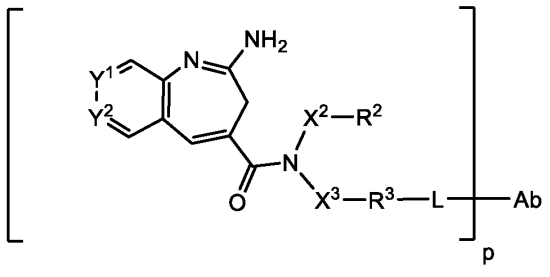
Assessment of activation of the described populations of myeloid cells may be performed as a mono-culture or as a co-culture with cells expressing the antigen of interest which the immunoconjugate (IC) may bind to via the CDR region of the antibody. Following

incubation for 18-48 hours, activation may be assessed by upregulation of cell surface co-stimulatory molecules using flow cytometry or by measurement of secreted proinflammatory cytokines. For cytokine measurement, cell-free supernatant is harvested and analyzed by cytokine bead array (e.g. LegendPlex from Biolegend) using flow cytometry.

All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

CLAIMS:

1. An immunoconjugate comprising an antibody covalently attached to one or more 2-amino-4-carboxamide-benzazepine moieties by a linker, and having Formula I:



I

or a pharmaceutically acceptable salt thereof,

wherein:

Ab is the antibody which is an antibody construct or antigen binding domain that binds to a target selected from the group consisting of PD-L1, HER2, TROP2, and CEA;

p is an integer from 1 to 8;

X^2 and X^3 are independently selected from the group consisting of a bond, C(=O), $C(=O)N(R^5)$, O, $N(R^5)$, S, $S(O)_2$, and $S(O)_2N(R^5)$;

Y^1 is CR^1 or N;

Y^2 is CH or N;

R^1 is selected from the group consisting of H, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^2 is selected from the group consisting of H, C_1-C_{12} alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_3-C_{12} carbocyclyl, C_6-C_{20} aryl, C_2-C_9 heterocyclyl, and C_1-C_{20} heteroaryl;

R^3 is selected from the group consisting of:

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–*;

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–C(=O)*;

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–C(=O)O–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–$N(R^5)$–$S(O_2)$–*;

–(C_1-C_{12} alkyldiyl)–OC(=O)–(C_2-C_9 heterocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–O–*;

–(C_1-C_{12} alkyldiyl)–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_6-C_{20} aryl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–N(R^5)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–*;

–(C_1-C_{12} alkyldiyl)–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_3-C_{12} carbocyclyldiyl)–NR^5–C(=NR^{5a})–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–*;

–(C_6-C_{20} aryldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_6-C_{20} aryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_2-C_{20} heterocyclyldiyl)–*;

–(C_2-C_9 heterocyclyldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_2-C_9 heterocyclyldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

–(C_1-C_{20} heteroaryldiyl)–*;

–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–N(R^5)–*;

–(C_1-C_{20} heteroaryldiyl)–(C_1-C_{12} alkyldiyl)–O–*; and

–(C_1-C_{20} heteroaryldiyl)–N(R^5)–C(=NR^{5a})–N(R^5)–*;

where the asterisk * indicates the attachment site of the linker L;

R^5 is selected from the group consisting of H, C_6-C_{20} aryl and C_1-C_{12} alkyl, or two R^5 groups together form a 5- or 6-membered heterocyclyl ring;

R^{5a} is selected from the group consisting of C_6-C_{20} aryl and C_1-C_{20} heteroaryl;

L is selected from the group consisting of:

–C(=O)–PEG–C(=O)–;

–C(=O)–PEG–C(=O)–PEP–;

–C(=O)–PEG–N(R^5)–;

–C(=O)–PEG–N(R^5)–C(=O)–;

–C(=O)–PEG–NR^5–PEG–C(=O)–PEP–;

–C(=O)–PEG–N^+(R^5)$_2$–PEG–C(=O)–PEP–;

–C(=O)–PEG–$NR^5CH(AA_1)C(=O)$–PEG–C(=O)–PEP–;

–C(=O)–PEG–O–;

–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–OC(=O)–;

–C(=O)–PEG–SS–(C_1-C_{12} alkyldiyl)–C(=O)–;

–C(=O)–PEG–;

–C(=O)–PEG–C(=O)$N(R^5)$–(C_1-C_{12} alkyldiyl)–$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)$N(R^5)$–(C_1-C_{12} alkyldiyl)–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)–;

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)–$N(R^5)$–C(=O);

–C(=O)–(C_1-C_{12} alkyldiyl)–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)–$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–;

–C(=O)–$CH_2CH_2OCH_2CH_2$–(C_1-C_{20} heteroaryldiyl)–CH_2O–PEG–C(=O)–(MCgluc)–$N(R^5)$–(C_1-C_{12} alkyldiyl)$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)$N(R^5)$–(C_1-C_{12} alkyldiyl)–;

–C(=O)–PEG–C(=O)$N(R^5)$–(C_1-C_{12} alkyldiyl)$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

–C(=O)–PEG–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)–;

–C(=O)–PEG–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

–succinimidyl–$(CH_2)_m$–C(=O)$N(R^5)$–PEG–C(=O)–;

–succinimidyl–$(CH_2)_m$–C(=O)$N(R^5)$–PEG–$N(R^5)$–;

–succinimidyl–$(CH_2)_m$–C(=O)$N(R^5)$–PEG–$N(R^5)$–C(=O)–;

–succinimidyl–$(CH_2)_m$–C(=O)$N(R^5)$–PEG–C(=O)–PEP–;

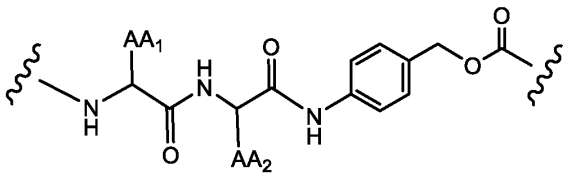
–succinimidyl–$(CH_2)_m$–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)–;

–succinimidyl–$(CH_2)_m$–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)$N(R^5)C(=O)$–; and

–succinimidyl–$(CH_2)_m$–C(=O)–PEP–$N(R^5)$–(C_1-C_{12} alkyldiyl)$N(R^5)C(=O)$–(C_2-C_5 monoheterocyclyldiyl)–;

PEG has the formula: $-(CH_2CH_2O)_n-(CH_2)_m-$ where m is an integer from 1 to 5, and n is an integer from 2 to 50;

PEP has the formula:



where AA_1 and AA_2 are independently selected from an amino acid side chain, or AA_1 or AA_2 and an adjacent nitrogen atom form a 5-membered ring proline amino acid, and the wavy line indicates a point of attachment; and

where alkyl, alkyldiyl, alkenyl, alkenyldiyl, alkynyl, alkynyldiyl, aryl, aryldiyl carbocyclyl, carbocyclyldiyl, heterocyclyl, heterocyclyldiyl, heteroaryl, and heteroaryldiyl are optionally substituted with one or more groups independently selected from F, Cl, Br, I, $-CN$, $-CH_3$, $-CH_2CH_3$, $-CH=CH_2$, $-C\equiv CH$, $-C\equiv CCH_3$, $-CH_2CH_2CH_3$, $-CH(CH_3)_2$, $-CH_2CH(CH_3)_2$, $-CH_2OH$, $-CH_2OCH_3$, $-CH_2CH_2OH$, $-C(CH_3)_2OH$, $-CH(OH)CH(CH_3)_2$, $-C(CH_3)_2CH_2OH$, $-CH_2CH_2SO_2CH_3$, $-CH_2OP(O)(OH)_2$, $-CH_2F$, $-CHF_2$, $-CF_3$, $-CH_2CF_3$, $-CH_2CHF_2$, $-CH(CH_3)CN$, $-C(CH_3)_2CN$, $-CH_2CN$, $-CH_2NH_2$, $-CH_2NHSO_2CH_3$, $-CH_2NHCH_3$, $-CH_2N(CH_3)_2$, $-CO_2H$, $-COCH_3$, $-CO_2CH_3$, $-CO_2C(CH_3)_3$, $-COCH(OH)CH_3$, $-CONH_2$, $-CONHCH_3$, $-CON(CH_3)_2$, $-C(CH_3)_2CONH_2$, $-NH_2$, $-NHCH_3$, $-N(CH_3)_2$, $-NHCOCH_3$, $-N(CH_3)COCH_3$, $-NHS(O)_2CH_3$, $-N(CH_3)C(CH_3)_2CONH_2$, $-N(CH_3)CH_2CH_2S(O)_2CH_3$, $-NO_2$, $=O$, $-OH$, $-OCH_3$, $-OCH_2CH_3$, $-OCH_2CH_2OCH_3$, $-OCH_2CH_2OH$, $-OCH_2CH_2N(CH_3)_2$, $-O(CH_2CH_2O)_n-(CH_2)_mCO_2H$, $-O(CH_2CH_2O)_nH$, $-OP(O)(OH)_2$, $-S(O)_2N(CH_3)_2$, $-SCH_3$, $-S(O)_2CH_3$, and $-S(O)_3H$.

2. The immunoconjugate of claim 1 wherein the antibody is an antibody construct that has an antigen binding domain that binds PD-L1.

3. The immunoconjugate of claim 2 wherein the antibody is selected from the group consisting of atezolizumab, durvalumab, and avelumab, or a biosimilar or a biobetter thereof.

4. The immunoconjugate of claim 1 wherein the antibody is an antibody construct that has an antigen binding domain that binds HER2.

5. The immunoconjugate of claim 4 wherein the antibody is selected from the group consisting of trastuzumab and pertuzumab, or a biosimilar or a biobetter thereof.

6. The immunoconjugate of claim 1 wherein the antibody is an antibody construct that has an antigen binding domain that binds CEA.

7. The immunoconjugate of claim 6 wherein the antibody is labetuzumab, or a biosimilar or a biobetter thereof.

8. The immunoconjugate of claim 1 wherein the antibody is an antibody construct that has an antigen binding domain that binds TROP2.

9. The immunoconjugate of claim 8 wherein the TROP2 antibody is a monoclonal antibody.

10. The immunoconjugate of any one of claims 1 to 9 wherein R^1 is optionally substituted C_1-C_{20} heteroaryl.

11. The immunoconjugate of any one of claims 1 to 9 wherein R^1 is pyrimidinyl or pyridinyl.

12. The immunoconjugate of any one of claims 1 to 9 wherein X^2 and X^3 are each a bond, and R^2 and R^3 are independently selected from C_1-C_8 alkyl, –O–(C_1-C_{12} alkyl), –(C_1-C_{12} alkyldiyl)–OR^5, –(C_1-C_8 alkyldiyl)–$N(R^5)CO_2R^5$, –(C_1-C_{12} alkyl)–$OC(O)N(R^5)_2$, –O–(C_1-C_{12} alkyl)–$N(R^5)CO_2R^5$, and –O–(C_1-C_{12} alkyl)–$OC(O)N(R^5)_2$.

13. The immunoconjugate of any one of claims 1 to 9 wherein X^2 is a bond, and R^2 is C_1-C_{12} alkyl.

14. The immunoconjugate of any one of claims 1 to 9 wherein X^3 is O and R^3 is –(C_1-C_{12} alkyldiyl)–$N(R^5)$–*.

15. The immunoconjugate of claim 14 wherein R^3 is $–CH_2CH_2CH_2NH–$.

16. The immunoconjugate of claim 14 wherein L is –C(=O)–PEG–C(=O)–.

17. The immunoconjugate of any one of claims 1 to 9 wherein L comprises PEG.

18. The immunoconjugate of claim 17 wherein n is 10 and m is 1.

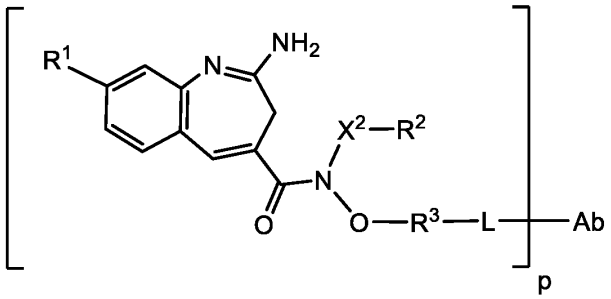
19. The immunoconjugate of any one of claims 1 to 9 wherein AA_1 and AA_2 are independently selected from a side chain of a naturally-occurring amino acid.

20. The immunoconjugate of claim 19 wherein AA_1 or AA_2 with an adjacent nitrogen atom form a 5-membered ring proline amino acid.

21. The immunoconjugate of claim 19 wherein AA_1 and AA_2 are independently selected from H, $–CH_3$, $–CH(CH_3)_2$, $–CH_2(C_6H_5)$, $–CH_2CH_2CH_2CH_2NH_2$, $–CH_2CH_2CH_2NHC(NH)NH_2$, $–CHCH(CH_3)CH_3$, $–CH_2SO_3H$, and $–CH_2CH_2CH_2NHC(O)NH_2$.

22. The immunoconjugate of claim 21 wherein AA_1 is $–CH(CH_3)_2$, and AA_2 is $–CH_2CH_2CH_2NHC(O)NH_2$.

23. The immunoconjugate of any one of claims 1 to 9 having Formula Ia:



Ia.

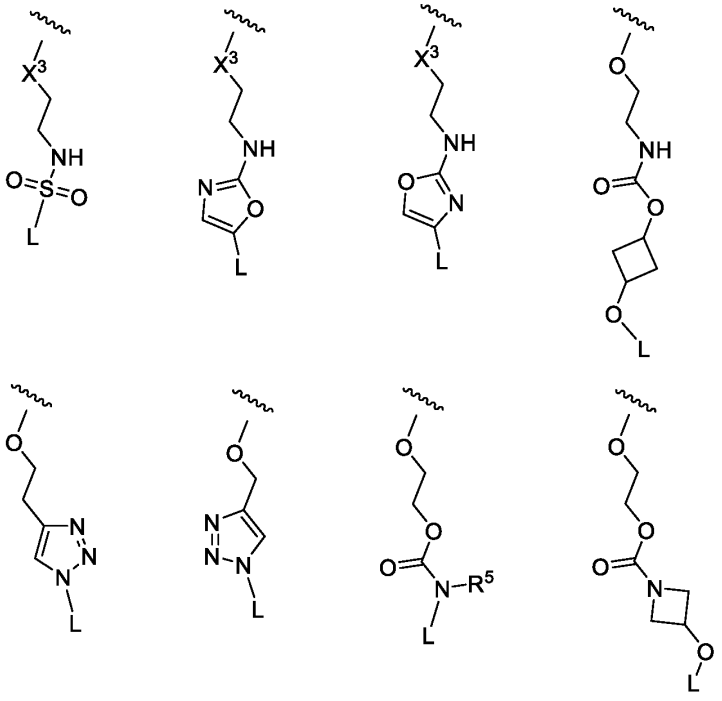
24. The immunoconjugate of claim 23 wherein R^1 is optionally substituted C_1-C_{20} heteroaryl.

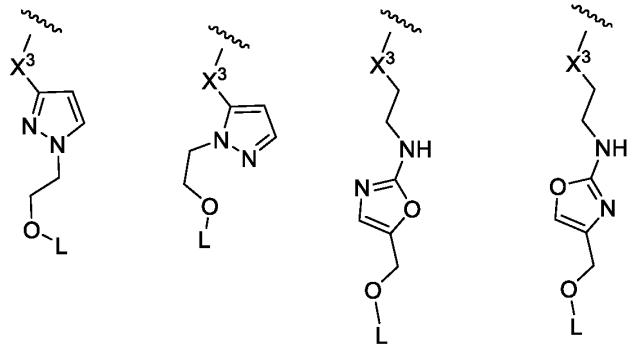
25. The immunoconjugate of claim 24 wherein R^1 is pyrimidinyl or pyridyl.

26. The immunoconjugate of claim 23 wherein X^2 is a bond, and R^2 is C_1-C_{12} alkyl.

27. The immunoconjugate of claim 23 wherein R^3 is –(C_1-C_{12} alkyldiyl)–N(R^5)–*.

28. The immunoconjugate of any one of claims 1 to 9 wherein X^3–R^3–L is selected from the group consisting of:





where the wavy line indicates the point of attachment to N.

29. The immunoconjugate of claim 28 wherein L comprises PEG.

30. The immunoconjugate of claim 29 wherein n is 10 and m is 1.

31. The immunoconjugate of any one of claims 1 to 9 wherein Y^1 is CR^1 and Y^2 is CH.

32. The immunoconjugate of any one of claims 1 to 9 wherein Y^1 is N and Y^2 is CH.

33. The immunoconjugate of any one of claims 1 to 9 wherein Y^1 is N and Y^2 is N.

34. A 2-amino-4-carboxamide-benzazepine-linker compound selected from Tables 2a and 2b.

35. An immunoconjugate prepared by conjugation of an antibody with a 2-amino-4-carboxamide-benzazepine-linker compound selected from Tables 2a and 2b.

36. A pharmaceutical composition comprising a therapeutically effective amount of an immunoconjugate according to any one of claims 1 to 9, and one or more pharmaceutically acceptable diluent, vehicle, carrier or excipient.

37. A method for treating cancer comprising administering a therapeutically effective amount of an immunoconjugate according to any one of claims 1 to 9, to a patient in need thereof, wherein the cancer is selected from bladder cancer, urinary tract cancer, urothelial carcinoma, lung cancer, non-small cell lung cancer, Merkel cell carcinoma, colon cancer, colorectal cancer, gastric cancer, and breast cancer.

38. The method of claim 37, wherein the cancer is susceptible to a pro-inflammatory response induced by TLR7 and/or TLR8 agonism.

39. The method of claim 37, wherein the breast cancer is triple-negative breast cancer.

40. The method of claim 37, wherein the Merkel cell carcinoma cancer is metastatic Merkel cell carcinoma.

41. The method of claim 39, wherein the cancer is gastroesophageal junction adenocarcinoma.

42. A method of preparing an immunoconjugate of Formula I of any one of claims 1 to 9 wherein the 2-amino-4-carboxamide-benzazepine-linker of claim 34 is conjugated with the antibody.

43. Use of an immunoconjugate according to any one of claims 1 to 9 for treating cancer selected from bladder cancer, urinary tract cancer, urothelial carcinoma, lung cancer, non-small cell lung cancer, Merkel cell carcinoma, colon cancer, colorectal cancer, gastric cancer, and breast cancer.