

SUMMARY

[0007a] In one aspect, the present disclosure refers to a antibody or antibody fragment comprising clone-paired heavy and light CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)

27924 BiPDL4-4 ₄	RASHSVVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

[0007b] In another aspect, the present disclosure refers to use of an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)

37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSYYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSYYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively, in the manufacture of a medicament for treating a subject having cancer, wherein the antibody or antibody fragment is for delivery to said subject

[0007c] In yet another aspect, the present disclosure refers to a hybridoma or engineered cell encoding an antibody or antibody fragment wherein the antibody or antibody fragment is characterized by clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
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37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)

37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

[0007d] In yet another aspect, the present disclosure refers to a vaccine formulation comprising one or more antibodies or antibody fragments characterized by clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

[0007e] In yet another aspect, the present disclosure refers to a method of detecting a PD-L1 or PD-L2 expressing cell in a subject comprising:

- (a) contacting a sample from said subject with an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)

27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSYYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSYYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)

37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)
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, respectively; and

(b) detecting a PD-L1 or PD-L2 expressing cell in said sample by binding of said antibody or antibody fragment to a cell in said sample.

[0007f] In yet another aspect, the present disclosure refers to use of an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)

27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively, in the manufacture of a medicament for treating immune suppression in a tumor microenvironment.

[0008] Thus, in accordance with the present disclosure, there is provided an antibody or antibody fragment that binds selectively to both PD-L1 and PD-L2 and having clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively. The antibody or antibody fragment may be encoded by clone-paired variable sequences as set forth in Table 1, may be encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired variable sequences as set forth in Table 1, or may be encoded by light and heavy chain variable sequences having 95% or greater identity to clone-paired sequences as set forth in Table 1. The antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% or greater identity to clone-paired sequences from Table 2.

[0009] There is also provided a method of treating cancer in a subject comprising contacting a PD-L1- or PD-L2-positive cancer cell in a subject with an antibody as

described above. The PD-L1- or PD-L2-positive cancer cell may be a solid tumor cell, such as a lung cancer cell, brain cancer cell, head & neck cancer cell, breast cancer cell, skin cancer cell, liver cancer cell, pancreatic cancer cell, stomach cancer cell, colon cancer cell, rectal cancer cell, uterine cancer cell, cervical cancer cell, ovarian cancer cell, testicular cancer cell, skin cancer cell, esophageal cancer cell, a lymphoma cell, a renal cell carcinoma cell, or may be a leukemia or myeloma such as acute myeloid leukemia, chronic myelogenous leukemia or multiple myeloma.

[0010] The method may further comprise contacting the PD-L1- or PD-L2-positive cancer cell with a second anti-cancer agent or treatment, such as chemotherapy, radiotherapy, immunotherapy, hormonal therapy, or toxin therapy. The second anti-cancer agent or treatment may inhibit an intracellular PD-L1 or PD-L2 function. The second anti-cancer agent or treatment may be given at the same time as the first agent, or given before and/or after the agent. The PD-L1- or PD-L2-positive cancer cell may be a metastatic cancer cell, a multiply drug resistant cancer cell or a recurrent cancer cell.

[0011] The antibody may be a single chain antibody, a single domain antibody, a chimeric antibody, or a Fab fragment. The antibody may be a human antibody, murine antibody, an IgG, a humanized antibody or a humanized IgG. The antibody or antibody fragment may further comprise a label, such as a peptide tag, an enzyme, a magnetic particle, a chromophore, a fluorescent molecule, a chemiluminescent molecule, or a dye. The antibody or antibody fragment may further comprise an antitumor drug linked thereto, such as linked to the antibody or antibody fragment through a photolabile linker or an enzymatically-cleaved linker. The antitumor drug may be a toxin, a radioisotope, a cytokine or an enzyme. The antibody or antibody fragment may be conjugated to a nanoparticle or a liposome

[0012] In another example, there is provided a method of treating a cancer in a subject comprising delivering to the subject an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively. The antibody fragment may be a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment. The antibody may be an IgG. The antibody may be is a chimeric antibody. Delivering may comprise antibody or antibody fragment administration, or genetic delivery with an RNA or DNA sequence or vector encoding the antibody or antibody fragment.

[0013] The antibody or antibody fragment may be encoded by clone-paired light and heavy chain variable sequences as set forth in Table 1, may be encoded by clone-paired light and heavy chain variable sequences having 95% identity to as set forth in Table 1, and may be encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired sequences from Table 1. The antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% identity to clone-paired sequences from Table 2.

[0014] Also provided is a monoclonal antibody, wherein the antibody or antibody fragment is characterized by clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively. The antibody fragment may be a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment. The antibody may be a chimeric antibody, or an IgG.

[0015] The antibody or antibody fragment may be encoded by clone-paired light and heavy chain variable sequences as set forth in Table 1, may be encoded by clone-paired light and heavy chain variable sequences having 95% identity to as set forth in Table 1, and may be encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired sequences from Table 1. The antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% identity to clone-paired sequences from Table 2.

[0016] In yet another example, there is provided a hybridoma or engineered cell encoding an antibody or antibody fragment wherein the antibody or antibody fragment is characterized by clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively. The antibody fragment may be a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment. The antibody may be a chimeric antibody or an IgG

[0017] The antibody or antibody fragment may be encoded by clone-paired light and heavy chain variable sequences as set forth in Table 1, may be encoded by clone-paired light and heavy chain variable sequences having 95% identity to as set forth in Table 1, and may be encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired sequences from Table 1. The antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% identity to clone-paired sequences from Table 2.

[0018] A further example comprises a cancer vaccine comprising one or more antibodies or antibody fragments characterized by clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively. At least one antibody fragment may be a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment. At least one of antibody may be a chimeric antibody, or an IgG. At least one antibody or antibody fragment may be encoded by clone-paired light and heavy chain variable sequences as set forth in Table 1, may be encoded by clone-paired light and heavy chain variable sequences having 95% identity to as set forth in Table 1, and may be

encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired sequences from Table 1. At least one antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% identity to clone-paired sequences from Table 2.

[0019] In another example there is provided a method of detecting PD-L1 or PD-L2 expressing cells in a subject comprising contacting a sample from said subject with an antibody or antibody fragment characterized by clone-paired heavy and light chain CDR sequences from Tables 3 and 4, respectively, and detecting a PD-L1 or PD-L2 expressing cell in said sample by binding said antibody or antibody fragment to a cell in said sample. The sample may be a body fluid or a tissue sample. The cell may be a cancer cell, such as a lymphoma cell, breast cancer cell, or renal cell carcinoma cell. The cell may be a cell associated with immune suppression. The cell associated with immune suppression may be a non-cancerous cell in a tumor microenvironment, such as a stromal cell or endothelial cell. Detection may comprise ELISA, RIA, or Western blot. The method may further comprise performing the method a second time and determining a change in orthopoxvirus antigen levels as compared to the first assay. The antibody or antibody fragment may be encoded by clone-paired light and heavy chain variable sequences as set forth in Table 1, may be encoded by clone-paired light and heavy chain variable sequences having 95% identify to as set forth in Table 1, and may be encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired sequences from Table 1. The antibody or antibody fragment may comprise light and heavy chain variable sequences according to clone-paired sequences from Table 2, may comprise light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from Table 2, or may comprise light and heavy chain variable sequences having 95% identity to clone-paired sequences from Table 2.

[0020] It is contemplated that any method or composition described herein can be implemented with respect to any other method or composition described herein. Other objects, features and advantages of the present disclosure will become apparent from the following detailed description. It should be understood, however, that the detailed description and the specific examples, while indicating specific examples of the

CLAIMS

1. An antibody or antibody fragment comprising clone-paired heavy and light CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)

27924 BiPDL4-4 ₄	RASHSVVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

- The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCTGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3

27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGATTGTCGCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11

21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGC AAAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGC AACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGTATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

3. The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 70%, 80%, or 90% identity to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCACTCTCCAGGCACCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8

27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAACTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTGTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTGTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10

21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGTGCGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTCACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

4. The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 95% identity to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7

27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9

27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTGCGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGTATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTGAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

5. The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67

37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVVIQPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVVIQPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSLSPGERATLSCRASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVITITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSKASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFDPWGQGT LVTVSS	25

20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISSLQPEDATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

6. The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVTITCRASQDISFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDNSTLYLQMNSLRADTAVY YCARAGIEYSYAYTDYWGGTTLTVSS	19

27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSLSPGERATLSCRASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF DIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSKASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED TAVY YCARVYRAASWFD PWGQGT LVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISSLQPEDIATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF DIWGQGTMTVTVSS	63

37464 Light BiPDL3-14	DIQMTQSPSSVSASVGDRVITICRASQGINFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-24	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	65
37465 Light BiPDL3-24	DIQMTQSPSSVSASVGDRVITICRASQGINFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-44	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-44	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

7. The antibody or antibody fragment of claim 1, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 95% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-34	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-34	DIQMTQSPSSVSASVGDRVITICRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-34	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	19
27907 Light BiPDL4-34	EIVLTQSPGTLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-14	QVQLVESGGGVLPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	15

27869 Light BiPDL4-1 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _{LVT} VSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _{LVT} VSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DIW} GQGT _{MVT} VSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQG _{ISS} WLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLT _{IS} SLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFD _{PD} WGQGT _{LVT} VSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFT _{IS} SLQPED _{IAT} YYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DIW} GQGT _{MVT} VSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLT _{IS} SLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DIW} GQGT _{MVT} VSS	65

37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

8. The antibody or antibody fragment of claims 1-7, wherein the antibody fragment is a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment.
9. The antibody or antibody fragment of claims 1-7, wherein said antibody is a chimeric antibody.
10. The antibody or antibody fragment of claims 1-9, wherein said antibody is an IgG.
11. The antibody or antibody fragment of claims 1-10, wherein said antibody or antibody fragment further comprises a cell penetrating peptide and/or is an intrabody.
12. The antibody or fragment of claims 1-11, wherein said antibody or antibody fragment is a human antibody.
13. The antibody or fragment of claims 1-11, wherein said antibody or antibody fragment is a humanized antibody.
14. Use of an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)

27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)

37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively, in the manufacture of a medicament for treating a subject having cancer, wherein the antibody or antibody fragment is for delivery to said subject.

15. The use of claim 14, the antibody or antibody fragment is encoded by clone-paired light and heavy chain variable sequences as set forth in

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4

27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTCAAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGACAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12

20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCA TGGAAGTGGATCTGGGACAGATTTTACTTTCACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAA	14

16. The use of claim 14-15, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 70%, 80%, or 90% identity to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCACTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTGCGCGGAGGGACCAAGGTTGAGATCAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3

27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGATTGTCGCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11

21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGTCAAAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGTAACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

17. The use of claim 14-15, the antibody or antibody fragment is encoded by clone-paired light and heavy chain variable sequences having at least 95% identity to clone-paired sequences as set forth in

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCACTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8

27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAACTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTACAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTACAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10

21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGTGCGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTCACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

18. The use of claim 14, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVTITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCLAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDNSTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGLTVTVSS	19

27907 Light BiPDL4-3 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RA _{SQ} FVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPG _{RS} LR _L SCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _L VT _{VSS}	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RA _{SQ} FVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPG _{RS} LR _L SCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _L VT _{VSS}	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RA _{NS} SVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPG _{RS} LR _L SCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _L VT _{VSS}	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RA _{SH} SVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSET _{LS} LTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSRVT} ISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DIW} GQGT _M VT _{VSS}	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGD _{RV} TITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} LQPEDFATYYCQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKV _{SCK} ASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED _{TAVY} YCARVYRAASWFD _{PWG} QGT _L VT _{VSS}	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGD _{RV} TITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTIS _{SL} LQPED _{IAT} YYCQPPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSET _{LS} LTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSRVT} ISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DIW} GQGT _M VT _{VSS}	63

37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVITICRASQGINFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVITICRASQGINFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

19. The use of claim 14, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITICRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	15

27869 Light BiPDL4-1 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _{LVT} VSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN _{SKNT} LYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _{LVT} VSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MVT} VSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKV _{SC} KASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED _{TAVY} YCARVYRAASWFD _{PW} GQGT _{LVT} VSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTIS _{SL} QPED _{IAT} YYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MVT} VSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KS} RV _{TIS} VDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MVT} VSS	65

37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

20. The use of claim 14, encoded by light and heavy chain variable sequences having 95% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITICRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCLASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVSS	17

27893 Light BiPDL4-2 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASNSV _{SS} YLAWYQQKPGQAPRL LIYGAA _{SR} ANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPG _{SL} R _{SL} SCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN _{SK} N _{TL} YLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT _{LV} TVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASHSV _{SS} YLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETL _{SL} TCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSR} VTISVD _{TS} KNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGI _{SS} WLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKV _{SC} KASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFD _{WP} GQGT _{LV} TVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTIS _{SL} QPEDIATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETL _{SL} TCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSR} VTISVD _{TS} KNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGIN _S FLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETL _{SL} TCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSR} VTISVD _{TS} KNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISN _F LAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETL _{SL} TCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _{KSR} VTISVD _{TS} KNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	69

37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70
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21. The use of claims 14-20, wherein the antibody fragment is a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment.
22. The use of claims 14-21, wherein said antibody is an IgG.
23. The use of claims 14-20, wherein said antibody is a chimeric antibody.
24. The use of claim 14-23, wherein the delivery comprises the antibody or antibody fragment to be administered to the subject, or genetic delivery with an RNA or DNA sequence or vector encoding the antibody or antibody fragment.
25. A hybridoma or engineered cell encoding an antibody or antibody fragment wherein the antibody or antibody fragment is characterized by clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464	GSLSGYPWS	ETDVSGWTDYNPSLKS	ARDGRRMGTPSFDI

BiPDL3-1 ₄	(72)	(73)	(74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVSSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVSSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

26. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
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27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTCCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAACTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTGTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTCCGGCGGAGGGACCAAGGTGGAGATCAAA	6

27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTACAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTGCGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTACCATCAGCAGCCTGC AGCCTGAAGATTTTGCACCTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAAGTGGATCTGGGACAGATTTTACTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

27. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 70%, 80%, or 90% identity to clone-paired variable sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTCCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAACTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5

27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCACCTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13

20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14
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28. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having 95% identity to clone-paired variable sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4

27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTCAAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGACAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12

20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGGTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTCACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAA	14

29. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITICRASQDISSFLAWYQQKPKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGTTLTVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGTTLTVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16

27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTLVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVVS SYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTLVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSLSPGERATLSCRASHSVVS SYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSW LAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED TAVY YCARVYRAASWFDWPWGQGTTLTVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISSLQPEDIATYYCQQP FHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66

37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

30. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 70%, 80%, or 90% identity to clone-paired variable sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRTITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18

27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQTLVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSPGERATLSCRASHSVVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED TAVY YCARVYRAASWFDPWGQGT LVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISLQPEDFATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

31. The hybridoma or engineered cell of claim 25, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 95% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVTITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCLASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTL SLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTL SLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTL SLSPGERATLSCRASN SVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPGRSRLSCLASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL SLSPGERATLSCRASH SVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22

21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGIISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFDPWGQGTMTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISLQPEDFATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

32. The hybridoma or engineered cell of claims 25-31, wherein the antibody fragment is a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment.

33. The hybridoma or engineered cell of claims 25-32, wherein said antibody is a chimeric antibody.
34. The hybridoma or engineered cell of claims 25-32, wherein said antibody is an IgG.
35. The hybridoma or engineered cell of claim 25-34, wherein said antibody or antibody fragment further comprises a cell penetrating peptide and/or is an intrabody.
36. A vaccine formulation comprising one or more antibodies or antibody fragments characterized by clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468	RASQDISSFLA	AASSLQD	QKSVYFPPT

BiPDL3-3 ₄	(93)	(94)	(95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVS SYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVS SYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively.

37. The vaccine formulation of claim 36, wherein at least one antibody or antibody fragment is encoded by light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7

27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9

27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGTATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTGAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

38. The vaccine formulation of claim 36, wherein at least one antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 70%, 80%, or 90% identity to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
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27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTGTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6

27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTACAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTGCGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

39. The vaccine formulation of claim 38, wherein at least one antibody or antibody fragment is encoded by light and heavy chain variable sequences having at least 95% identity to clone-paired sequences from

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5

27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13

20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAA	14
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40. The vaccine formulation of claim 36, wherein at least one antibody or antibody fragment comprises light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18

27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSPGERATLSCRASHSVVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED TAVY YCARVYRAASWFDPWGQGLTVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISLQPEDFATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

41. The vaccine formulation of claim 36, wherein at least one antibody or antibody fragment comprises light and heavy chain variable sequences having 95% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVTITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTL SLSPGERATL SCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTL SLSPGERATL SCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTL SLSPGERATL SCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL SLSPGERATL SCRAHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22

21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGIISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSCASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDNAVY YCARVYRAASWFDPWGQGTMTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTISLQPEDFATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

42. The vaccine formulation of claims 36-41, wherein at least one antibody fragment is a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment.

43. The vaccine formulation of claims 36-41, wherein at least one antibody is a chimeric antibody.
44. The vaccine formulation of claims 36-43, wherein at least one antibody is an IgG.
45. The vaccine formulation of claims 36-44, wherein at least one antibody or antibody fragment further comprises a cell penetrating peptide and/or is an intrabody.
46. A method of detecting a PD-L1 or PD-L2 expressing cell in a subject comprising:
- (a) contacting a sample from said subject with an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)
37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1	CDRL2	CDRL3
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	(SEQ ID NO:)	(SEQ ID NO:)	(SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVSSYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVSSYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively; and

(b) detecting a PD-L1 or PD-L2 expressing cell in said sample by binding of said antibody or antibody fragment to a cell in said sample.

47. The method of claim 46, wherein said sample is a body fluid.
48. The method of claims 46-47, wherein said sample is tissue sample.
49. The method of claims 46-47, wherein detection comprises ELISA, RIA or Western blot.
50. The method of claims 46-49, further comprising performing steps (a) and (b) a second time and determining a change in orthopoxvirus antigen levels as compared to the first assay.

51. The method of claims 46-50, wherein the antibody or antibody fragment is encoded by clone-paired variable sequences as set forth in

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5

27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTTCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTCAAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13

20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14
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52. The method of claims 46-50, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having 70%, 80%, or 90% identity to clone-paired variable sequences as set forth in

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3
27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTTGGCGGAGGGACCAAGGTGGAGATCAAA	4

27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTCAAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTGAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGAGTTCCGATGG TGGCCTCCTAGGACTTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGGATTTCGTCAACCACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGACAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTTCGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11
21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCACCATCACTTGTGCGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGCAGAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGCAGTTATTACTGTGAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12

20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTTGATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAA	14

53. The method of claims 46-50, wherein said antibody or antibody fragment is encoded by light and heavy chain variable sequences having 95% identity to clone-paired sequences as set forth in

Clone	Variable Sequence Region	SEQ ID NO:
27907 Heavy BiPDL4-3 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	7
27907 Light BiPDL4-3 ₄	GAAATTGTGTTGACGCACTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCGCCAGGGCCGCCGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTATGCAGTTCGGATGG TGGCCTCCTAGGACTTTGCGCGGAGGGACCAAGGTTGAGATCAA	8
27869 Heavy BiPDL4-1 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	3

27869 Light BiPDL4-1 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGTTCGTTTACAGCA GCGACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCACCAGGAAAACCTGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTCTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	4
27893 Heavy BiPDL4-2 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCGATGAGT ATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGTTATAGGGTATGATGGACTGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	5
27893 Light BiPDL4-2 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTAACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCAGCCAGCAGGGCCAACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTTCAAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	6
27924 Heavy BiPDL4-4 ₄	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGATCCAGCCTGGGAG GTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTACCTTCAGTGCCT ATCTTATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGG GTGGCAGCTATAGGTTATGATGGAATGAATAAATACTATGCAGACTC CGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCAAGAACACGC TGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACACGGCGGTGTAC TACTGCGCCAGAGCTGGAATAGAATACAGCTACGCCTATACTGATTA CTGGGGACAGGGTACATTGGTCACCGTCTCCTCA	9
27924 Light BiPDL4-4 ₄	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAGG GGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCACAGTGTTGTCAGCA GCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAGGCTC CTCATCTATGGTGCATCCAGCAGGGAAGACGGCATCCCAGACAGGTT CAGTGGCAGTGGGTCTGGGACAGACTTCACTCTCACCATCAGCAGAC TGGAGCCTGAAGATTTTGCAGTGTATTACTGTGTGCAGTTCGGATGG TGGCCTCCTAGGACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	10
21680 Heavy BiPDL3-1 ₃	CAAGTACAATTACAACAGTGGGGAGCTGGTTTATTAAAGCCTTCAGA AACTTTAAGTTTGACCTGTGCTGTTTACGGTGGATCATTATCTGGTT ATCCTTGGTCTTGATTGTCGTCACCAACCAGGCAAAGGATTGGAGTGG ATCGGTGAGACAGACGTGTGAGGCTGGACTGACTACAATCCAAGTTT AAAATCCAGGGTTACTATCTCCGTAGACACGTCCAAGAACCAGTTCT CCCTGAAGCTGAGTTCTGTGACCGCCGCAGACACGGCGGTGTACTAC TGCGCCAGAGACGGCAGAAGGATGGGTACCCCTTCATTGACATATG GGGCCAGGGTACAATGGTCACCGTCTCCTCA	11

21680 Light BiPDL3-1 ₃	GACATCCAGTTGACCCAGTCTCCATCTTCCGTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGTCTGGGCGAGTCAGGGTATTAGCAGCT GGTTAGCCTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTATGCTGCATCAAGTTTGTCAAAGTGGGGTCCCATCAAGTTTCAG CGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAGCAGCCTGC AGCCTGAAGATTTTGTCAACTTATTACTGTCAGCAGTACGTCTACTTC CCTCCTACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	12
20786 Heavy BiPDL2-1 ₂	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGGTC CTCGGTGAAGGTCTCCTGCAAGGCTTCTGGAGGCACCTTCAGCAGCT GGTTGATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTGAGTGG ATGGGAGGGATCATCCCTATCCTGGGTACAGCACGGTACGCACAGAA GTTCCAGGGCAGAGTCACGATTACCGCGGACGAATCCACGAGCACAG CCTACATGGAGCTGAGCAGCCTGAGATCTGAGGACACGGCGGTGTAC TACTGCGCCAGAGTGTACAGAGCTGCTTCTTGTTTGTATCCCTGGGG ACAGGGTACATTGGTCACCGTCTCCTCA	13
20786 Light BiPDL2-1 ₂	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGG AGACAGAGTCAACATCACTTGCCAGGCGAGTCAGGACATTAGCAACT ATTTAAATTGGTATCAGCAGAAACCAGGGAAAGCCCCTAAGCTCCTG ATCTACGATGCATCCAATTTGGAAACAGGGGTCCCATCAAGTTTCAG TGGAAGTGGATCTGGGACAGATTTTACTTTTACCATCAGCAGCCTGC AGCCTGAAGATATTGCAACATATTACTGTCAGCAGCCCTTCCACCTC ATCACTTTTGGCGGAGGGACCAAGGTTGAGATCAAA	14

54. The method of claims 46-50, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences according to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTVISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRTITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVLPGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	15

27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSLRLSCAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQGRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGT LVTVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSLSPGERATLSCRASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF DIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQG ISSLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLT ISSLQPEDFATYYCQQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSKASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSED TAVY YCARVYRAASWFD PWGQGT LVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFT ISSLQPEDIATYYCQQPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF DIWGQGTMTVTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLT ISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKS RVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF DIWGQGTMTVTVSS	65

37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITICRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

55. The method of claims 46-50, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 70%, 80% or 90% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITICRASQDISFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCLASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDNKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGQGTMTVTVSS	17

27893 Light BiPDL4-2 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASNSV _{SS} YLAWYQQKPGQAPRL LIYGAA _{SR} ANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGV _{IQ} GRSLRLSCAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN _{SK} N _{TL} YLQMNSLRAEDTAVY YCARAGIEYSAYTDYWGQGT _{LV} TVSS	21
27924 Light BiPDL4-4 ₄	EIVLTQSPGTL _{SL} SPGERATL _{SC} RASHSV _{SS} YLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLK _P SETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _K SRVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQ _{QY} YVF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKV _{SC} KASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFD _P WGQGT _{LV} TVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSRFSGSGSGTDFTFTIS _{SL} QPED _{IAT} YYCQ _Q PFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLK _P SETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _K SRVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQ _K AVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLK _P SETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _K SRVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISNFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTIS _{SL} QPEDFATYYCQ _K AVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLK _P SETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSL _K SRVTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSF _{DI} WGQGT _{MV} TVSS	69

37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVITITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70
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56. The method of claims 46-50, wherein said antibody or antibody fragment comprises light and heavy chain variable sequences having 95% identity to clone-paired sequences from

Clone	Variable Sequence	SEQ ID NO:
37468 Heavy BiPDL3-3 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVSS	67
37468 Light BiPDL3-3 ₄	DIQMTQSPSSVSASVGDRVITITCRASQDISSFLAWYQQKPGKAPKLL IYAASSLQDGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKSVYF PPTFGGGTKVEIK	68
27907 Heavy BiPDL4-3 ₄	QVQLVESGGGVIQPGRSRLSCLAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	19
27907 Light BiPDL4-3 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASARAAGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCMQFGW WPPRTFGGGTKVEIK	20
27869 Heavy BiPDL4-1 ₄	QVQLVESGGGVVQPGRSRLSCLAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	15
27869 Light BiPDL4-1 ₄	EIVLTQSPGTLSLSPGERATLSCRASQFVYSSDLAWYQQKPGQAPRL LIYGASTRKTGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCLQFGW WPPRTFGGGTKVEIK	16
27893 Heavy BiPDL4-2 ₄	QVQLVESGGGVVQPGRSRLSCLAASGFTFDEYGMHWVRQAPGKGLEW VAVIGYDGLNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	17
27893 Light BiPDL4-2 ₄	EIVLTQSPGTLSLSPGERATLSCRASNSVSSYLAWYQQKPGQAPRL LIYGAASRANGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	18
27924 Heavy BiPDL4-4 ₄	QVQLVESGGGVIQPGRSRLSCLAASGFTFSAYLMHWVRQAPGKGLEW VAAIGYDGMNKYYADSVKGRFTISRDN SKNTLYLQMNSLRAEDTAVY YCARAGIEYSYAYTDYWGGQGLTVTVSS	21

27924 Light BiPDL4-4 ₄	EIVLTQSPGTLSSLSPGERATLSCRASHSVSSYLAWYQQKPGQAPRL LIYGASSREDGIPDRFSGSGSGTDFTLTISRLEPEDFAVYYCVQFGW WPPRTFGGGTKVEIK	22
21680 Heavy BiPDL3-1 ₃	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	23
21680 Light BiPDL3-1 ₃	DIQLTQSPSSVSASVGDRVTITCRASQGIISSWLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQYVYF PPTFGGGTKVEIK	24
20786 Heavy BiPDL2-1 ₂	QVQLVQSGAEVKKPGSSVKVSKASGGTFSSWLISWVRQAPGQGLEW MGGIIPILGTARYAQKFQGRVTITADESTSTAYMELSSLRSEDTAVY YCARVYRAASWFDPWGQGTTLTVTVSS	25
20786 Light BiPDL2-1 ₂	DIQMTQSPSSLSASVGDRVTITCQASQDISNYLNWYQQKPGKAPKLL IYDASNLETGVPSPRFSGSGSGTDFTFTISSLQPEDFATYYCQPPFHL ITFGGGTKVEIK	26
37464 Heavy BiPDL3-1 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	63
37464 Light BiPDL3-1 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLNSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	64
37465 Heavy BiPDL3-2 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	65
37465 Light BiPDL3-2 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGINSFLAWYQQKPGKAPKLL IYAASSLQSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQKAVYF PPTFGGGTKVEIK	66
37475 Heavy BiPDL3-4 ₄	QVQLQQWGAGLLKPSETLSLTCAVYGGSLSGYPWSWIRQPPGKGLEW IGETDVSGWTDYNPSLKSRTISVDTSKNQFSLKLSSVTAADTAVYY CARDGRRMGTPSFDIWGQGTMTVTVSS	69
37475 Light BiPDL3-4 ₄	DIQMTQSPSSVSASVGDRVTITCRASQGISTFLAWYQQKPGKAPKLL IYAASALHSGVPSRFSGSGSGTDFTLTISLQPEDFATYYCQRAVYF PPTFGGGTKVEIK	70

57. The method of claims 46-56, wherein the antibody fragment is a recombinant scFv (single chain fragment variable) antibody, Fab fragment, F(ab')₂ fragment, or Fv fragment.
58. The method of claims 46-57, wherein said cell is a cancer cell.
59. The method of claim 58, wherein the cancer cell is a lymphoma cell, a breast cancer cell, or renal cell carcinoma cell.
60. The method of claims 46-57, wherein said cell is a cell associated with immune suppression.
61. The method of claim 60, wherein said cell associated with immune suppression is a non-cancerous cell in the tumor microenvironment.
62. The method of claim 61, wherein said non-cancerous cell in the tumor microenvironment is a stromal or endothelial cell.
63. Use of an antibody or antibody fragment having clone-paired heavy and light chain CDR sequences from

Antibody	CDRH1 (SEQ ID NO:)	CDRH2 (SEQ ID NO:)	CDRH3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	GSLSGYPWS (78)	ETDVSGWTDYNPSLKS (79)	ARDGRRMGTPSFDI (80)
27907 BiPDL4-3 ₄	FTFSAYLMH (33)	AIGYDGMNKYYADSVKG (34)	ARAGIEYSYAYTDY (35)
27869 BiPDL4-1 ₄	FTFDEYGMH (27)	VIGYDGLNKYYADSVKG (28)	ARAGIEYSYAYTDY (29)
27893 BiPDL4-2 ₄	FTFDEYGMH (30)	VIGYDGLNKYYADSVKG (31)	ARAGIEYSYAYTDY (32)
27924 BiPDL4-4 ₄	FTFSAYLMH (36)	AIGYDGMNKYYADSVKG (37)	ARAGIEYSYAYTDY (38)
21680 BiPDL3-1 ₃	GSLSGYPWS (39)	ETDVSGWTDYNPSLKS (40)	ARDGRRMGTPSFDI (41)
20786 BiPDL2-1 ₂	GTFSSWLIS (42)	GIIPILGTARYAQKFQG (43)	ARVYRAASWFDP (44)

37464 BiPDL3-1 ₄	GSLSGYPWS (72)	ETDVSGWTDYNPSLKS (73)	ARDGRRMGTPSFDI (74)
37465 BiPDL3-2 ₄	GSLSGYPWS (75)	ETDVSGWTDYNPSLKS (76)	ARDGRRMGTPSFDI (77)
37475 BiPDL3-4 ₄	GSLSGYPWS (81)	ETDVSGWTDYNPSLKS (82)	ARDGRRMGTPSFDI (83)
37477 BiPDL3-5 ₄	GSLSGYPWS (84)	ETDVSGWTDYNPSLKS (85)	ARDGRRMGTPSFDI (86)

and from

Antibody	CDRL1 (SEQ ID NO:)	CDRL2 (SEQ ID NO:)	CDRL3 (SEQ ID NO:)
37468 BiPDL3-3 ₄	RASQDISSFLA (93)	AASSLQD (94)	QKSVYFPPT (95)
27907 BiPDL4-3 ₄	RASQFVYSSDLA (51)	GASARAA (52)	MQFGWWPPRT (53)
27869 BiPDL4-1 ₄	RASQFVYSSDLA (45)	GASTRKT (46)	LQFGWWPPRT (47)
27893 BiPDL4-2 ₄	RASNSVVSYYLA (48)	GAASRAN (49)	VQFGWWPPRT (50)
27924 BiPDL4-4 ₄	RASHSVVSYYLA (54)	GASSRED (55)	VQFGWWPPRT (56)
21680 BiPDL3-1 ₃	RASQGISSWLA (57)	AASSLQS (58)	QQYVYFPPT (59)
20786 BiPDL2-1 ₂	QASQDISNYLN (60)	DASNLET (61)	QQPFHLIT (62)
37464 BiPDL3-1 ₄	RASQGINSFLA (87)	AASSLNS (88)	QKAVYFPPT (89)
37465 BiPDL3-2 ₄	RASQGISNFLA (90)	AASSLQS (91)	QKAVYFPPT (92)
37475 BiPDL3-4 ₄	RASQGISTFLA (96)	AASALHS (97)	QRAVYFPPT (98)
37477 BiPDL3-5 ₄	RASKGISSFLA (99)	AADSIQS (100)	QSAVYFPPT (101)

, respectively, in the manufacture of a medicament for treating immune suppression in a tumor microenvironment.