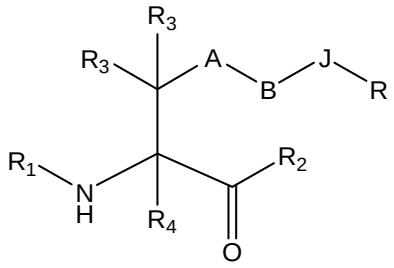
WHAT IS CLAIMED IS:

1. A compound, or salt thereof, comprising Formula (I):

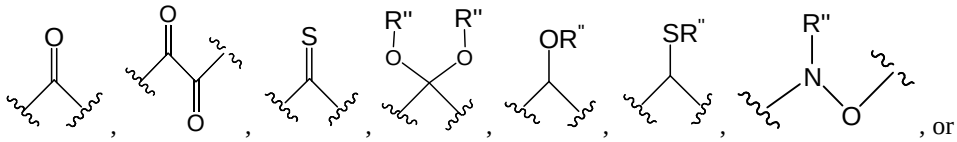
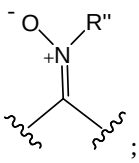


(I)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

J is , or ;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

each R" is independently H, alkyl, substituted alkyl, or a protecting group, or when more than one R" group is present, two R" optionally form a heterocycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

or the –A-B-J-R groups together form a bicyclic or tricyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group, protected carbonyl group, including a protected dicarbonyl group, or masked carbonyl group, including a masked dicarbonyl group;

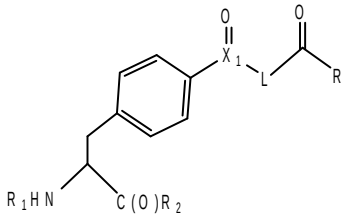
or the –J-R group together forms a monocyclic or bicyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group; at least one protected carbonyl group, including a protected dicarbonyl group; at least one masked carbonyl group, including a masked dicarbonyl group; or combinations thereof;

with a proviso that when A is phenylene and each R_3 is H, B is present; and that when A is $–(CH_2)_4-$ and each R_3 is H, B is not $–NHC(O)(CH_2CH_2)-$; and that when A and B are absent and each R_3 is H, R is not methyl;

or an active metabolite, or a pharmaceutically acceptable prodrug or solvate thereof.

2. The compound of claim 1, wherein A is substituted or unsubstituted lower alkylene, or an unsubsituted or substituted arylene selected from the group consisting of a phenylene, pyridinylene, pyrimidinylene or thiophenylene.

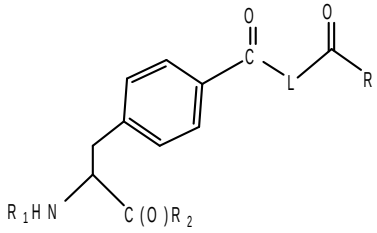
3. The compound of claim 1, corresponding to Formula (XXXIII):



(XXXIII);

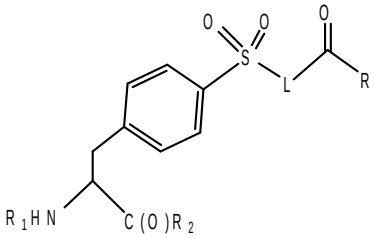
wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

4. The compound of claim 3, corresponding to Formula (XXXIII-A):



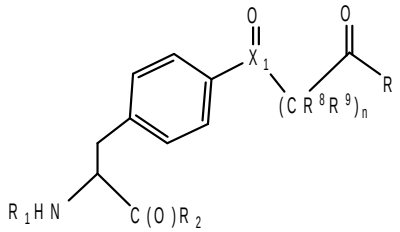
(XXXIII-A).

5. The compound of claim 3, corresponding to Formula (XXXIII-B):



(XXXIII-B).

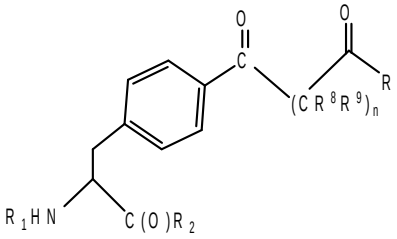
6. The compound of claim 1, corresponding to Formula (XXXIV):



(XXXIV);

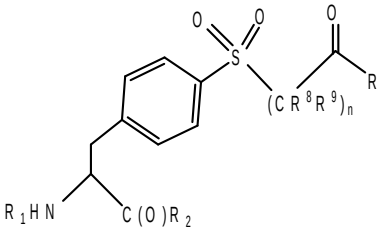
wherein X_1 is C, S, or S(O); and n is 0, 1, 2, 3, 4, or 5; and each R^8 and R^9 on each CR^8R^9 group is independently selected from the group consisting of H, alkoxy, alkylamine, halogen, alkyl, aryl, or any R^8 and R^9 can together form =O or a cycloalkyl, or any to adjacent R^8 groups can together form a cycloalkyl.

7. The compound of claim 6, corresponding to Formula (XXXIV-A):



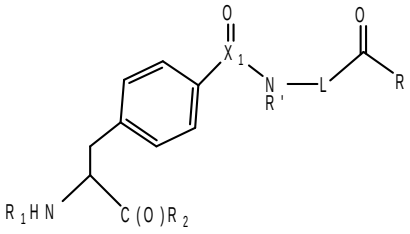
(XXXIV-A).

8. The compound of claim 6, corresponding to Formula (XXXIV-B):



(XXXIV-B).

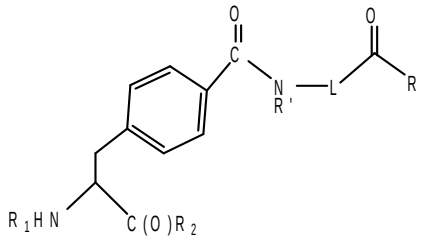
9. The compound of claim 1, corresponding to Formula (XXXV):



(XXXV);

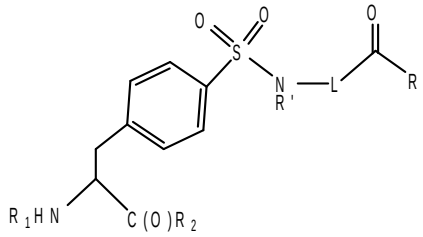
wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

10. The compound of claim 9, corresponding to Formula (XXXV-A):



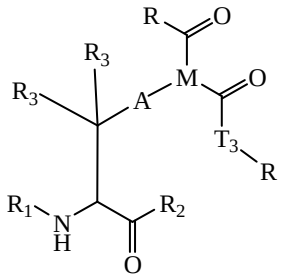
(XXXV-A).

11. The compound of claim 9, corresponding to Formula (XXXV-B):



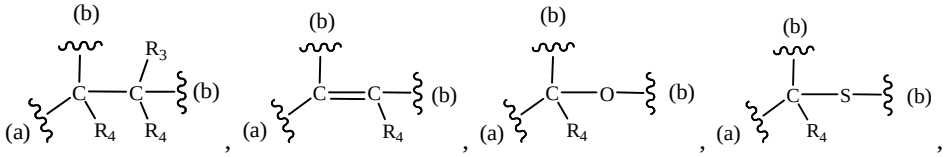
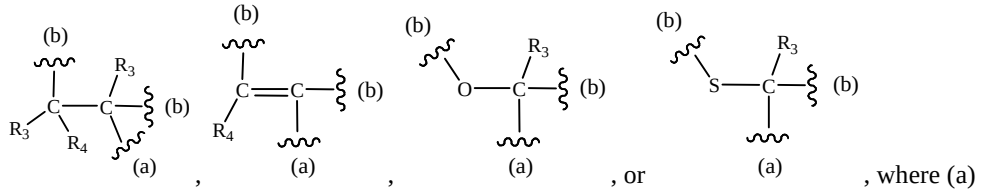
(XXXV-B).

12. The compound of claim 1, corresponding to Formula (XXXX):



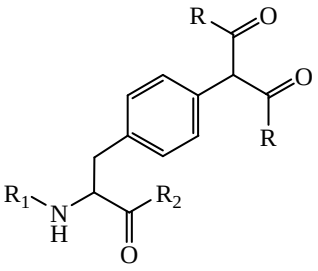
(XXXX)

wherein:

M is –C(R_3)-, , , where (a) indicates bonding to the A group and (b) indicates bonding to respective carbonyl groups; and

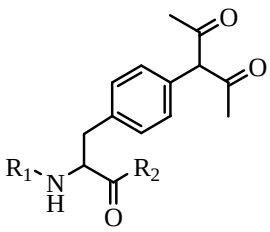
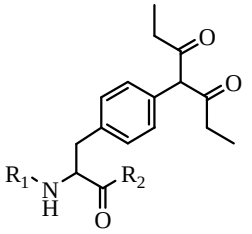
T_3 is a bond, C(R)(R), O, or S, and R is H, halogen, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

13. The compound of claim 12, corresponding to Formula (XXXXIII):

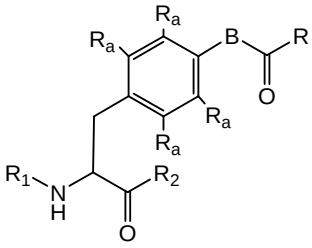


(XXXXIII)

14. The compound of claim 13, selected from:


, or


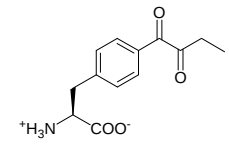
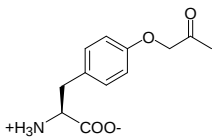
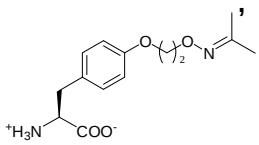
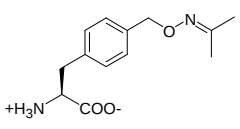
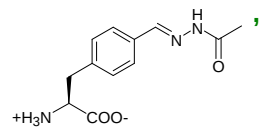
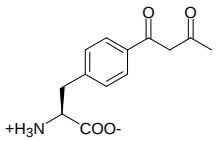
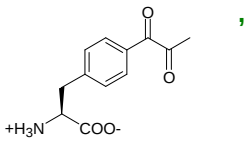
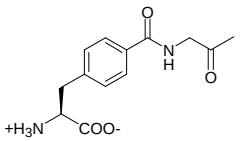
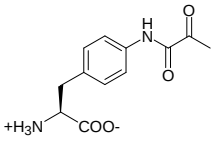
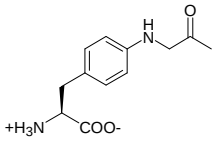
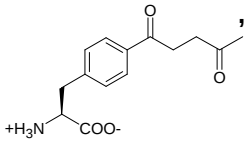
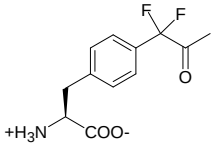
15. The compound of claim 1, corresponding to Formula (III):

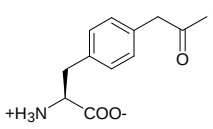
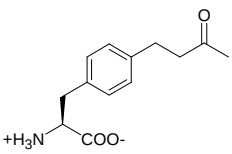
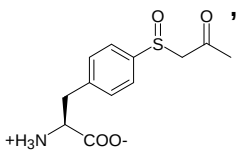
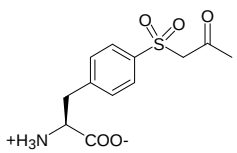
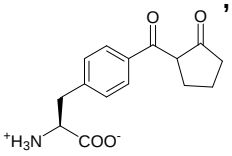
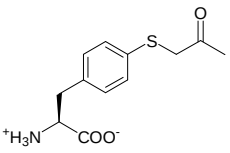
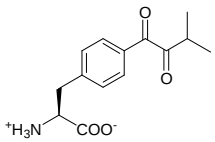
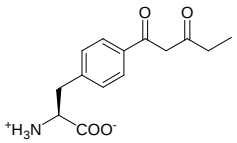
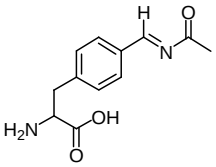


(III)

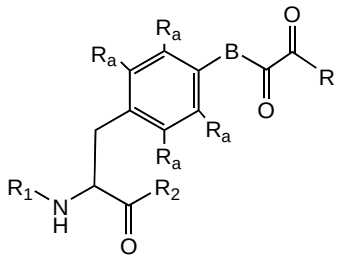
wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, -OR', and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

16. The compound of claim 15, selected from the group consisting of:


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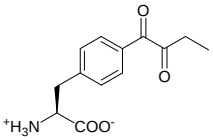
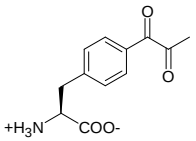
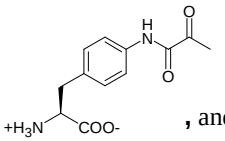
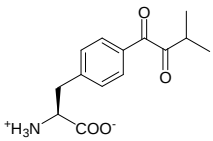
17. The compound of claim 1, corresponding to Formula (VI):



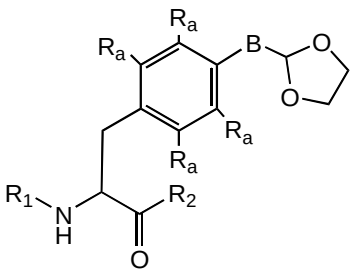
(VI)

wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, $-OR'$, and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

18. The compound of claim 17, selected from the group consisting of:


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, and

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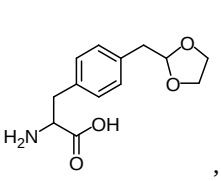
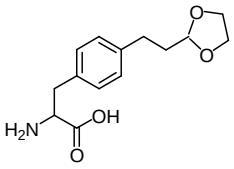
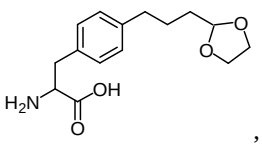
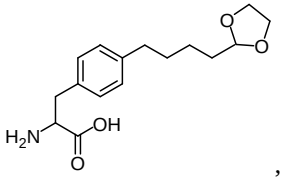
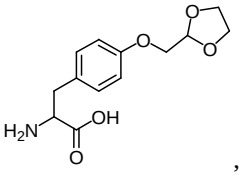
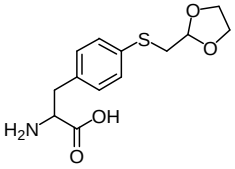
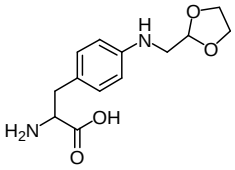
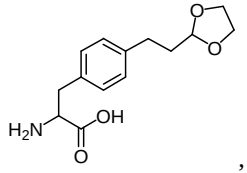
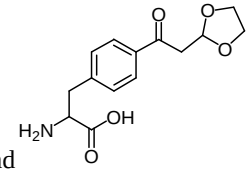
19. The compound of claim 1, corresponding to Formula (IX):



(IX)

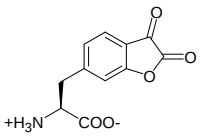
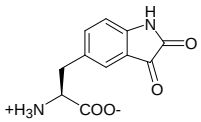
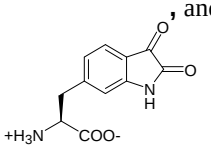
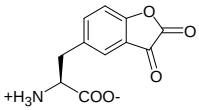
wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, -OR', and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

20. The compound of claim 19, selected from the group consisting of:


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and

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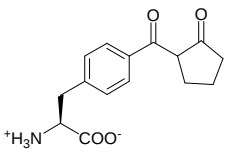
21. The compound of claim 1, wherein the –A-B-J-R groups together form a bicyclic or tricyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, protected carbonyl group or masked carbonyl group.

22. The compound of claim 21 selected from the group consisting of:


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, and

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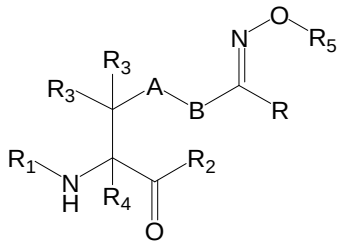
23. The compound of claim 1, wherein the –J-R group together forms a monocyclic or bicyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, protected carbonyl group or masked carbonyl group.

24. The compound of claim 23 having the structure:


.

25. A polypeptide incorporating at least one compound of claim 1.

26. A compound, or salt thereof, or an active metabolite, or a pharmaceutically acceptable prodrug or solvate thereof, comprising Formula (XI):



(XI)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

R_5 is H, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, alkoxy, substituted alkoxy, alkylalkoxy, substituted alkylalkoxy, polyalkylene oxide, substituted polyalkylene oxide, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkaryl, substituted alkaryl, aralkyl, substituted aralkyl, -(alkylene or substituted alkylene)-$ON(R")_2$, -(alkylene or substituted alkylene)-C(O)SR", -(alkylene or substituted alkylene)-S-S-(aryl or substituted aryl), -C(O)R", $-C(O)_2R"$, or $-C(O)N(R")_2$, wherein each R" is independently hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkoxy, substituted alkoxy, aryl, substituted aryl, heteroaryl, alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl;

or R_5 is L-X, where

X is a selected from the group consisting of a label; a dye; a polymer; a water-soluble polymer; a derivative of polyethylene glycol; a photocrosslinker; a cytotoxic compound; a drug; an affinity label; a photoaffinity label; a reactive compound; a resin; a second protein or polypeptide or polypeptide analog; an antibody or antibody fragment; a metal chelator; a cofactor; a fatty acid; a carbohydrate; a polynucleotide; a DNA; a RNA; an antisense polynucleotide; a saccharide, a water-soluble dendrimer, a cyclodextrin, a biomaterial; a nanoparticle; a spin label; a fluorophore, a metal-containing moiety; a radioactive moiety; a novel functional group; a group that covalently or noncovalently interacts with other molecules; a photocaged moiety; a photoisomerizable moiety; biotin; a biotin analogue; a moiety incorporating a heavy atom; a chemically cleavable group; a photocleavable group; an elongated side chain; a carbon-linked sugar; a redox-active agent; an amino thioacid; a toxic moiety; an isotopically labeled moiety; a biophysical probe; a phosphorescent group; a chemiluminescent group; an electron dense group; a magnetic group; an intercalating group; a chromophore; an energy transfer agent; a biologically active agent; a detectable label; and any combination of the above; and

L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -(alkylene or substituted alkylene)-O-N=CR'-, -(alkylene or substituted alkylene)-C(O)NR'-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-$S(O)_k$-(alkylene or substituted alkylene)-S-, -(alkylene or substituted alkylene)-S-S-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

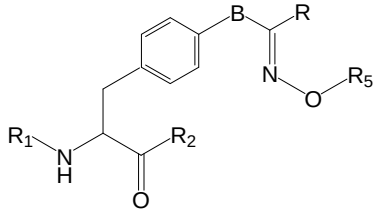
with a proviso that when A and B are absent, R is not methyl; and

excluding compounds of Formula (XI) wherein A is phenylene; B is a bond; R_1 is H, an amino protecting group, or at least one amino acid; R_2 is OH, an ester protecting group, or at least one amino acid; R is alkyl; each of R_3 and R_4 is H; R_5 is L-X, where X is selected from the group consisting of a polyalkylene glycol or a detectable label, wherein the detectable label is selected from a fluorescent, phosphorescent, chemiluminescent, chelating, intercalating, radioactive, and chromophoric moiety; and any combination thereof; and L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-(alkylene or substituted alkylene)-, -S-(alkylene or substituted alkylene)-, -

$S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-O-N=CR'-, -(alkylene or substituted alkylene)-C(O)NR'-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-$S(O)_k$-(alkylene or substituted alkylene)-S-, -(alkylene or substituted alkylene)-S-S-, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -$C(R')_2$-N=N-, and -$C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl.

27. The compound of claim 26, wherein A is phenylene or substituted phenylene.

28. The compound of claim 26, corresponding to Formula (XII):



(XII).

29. A polypeptide incorporating at least one compound of claim 26.

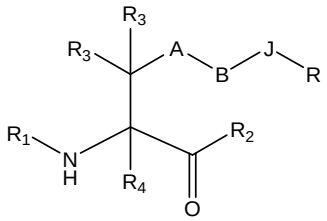
30. The compound of claim 26, wherein X is a biologically active agent selected from the group consisting of a peptide, protein, enzyme, antibody, drug, dye, lipid, nucleosides, oligonucleotide, cell, virus, liposome, microparticle, and micelle.

31. The compound of claim 30, wherein X is a drug selected from the group consisting of an antibiotic, fungicide, anti-viral agent, anti-inflammatory agent, anti-tumor agent, cardiovascular agent, anti-anxiety agent, hormone, growth factor, and steroidal agent.

32. The compound of claim 30, wherein X is an enzyme selected from the group consisting of horseradish peroxidase, alkaline phosphatase, β-galactosidase, and glucose oxidase.

33. The compound of claim 26, wherein X is a detectable label selected from the group consisting of a fluorescent, phosphorescent, chemiluminescent, chelating, electron dense, magnetic, intercalating, radioactive, chromophoric, and energy transfer moiety.

34. A method of producing a polypeptide comprising at least one amino acid having a structure of Formula (I):

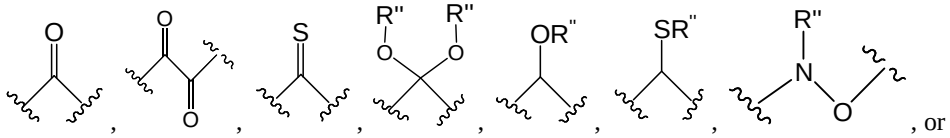
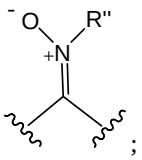


(I)

the method comprising incorporating the amino acid of Formula (I) into a terminal or internal position within the polypeptide, wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

J is , or ;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

each R" is independently H, alkyl, substituted alkyl, or a protecting group, or when more than one R" group is present, two R" optionally form a heterocycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

or the –A-B-J-R groups together form a bicyclic or tricyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group, protected carbonyl group, including a protected dicarbonyl group, or masked carbonyl group, including a masked dicarbonyl group;

or the –J-R group together forms a monocyclic or bicyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group, protected carbonyl group, including a protected dicarbonyl group, or masked carbonyl group, including a masked dicarbonyl group;

with a proviso that when A is phenylene and each R_3 is H, B is present; and that when A is $-(CH_2)_4-$ and each R_3 is H, B is not $-NHC(O)(CH_2CH_2)-$; and that when A and B are absent and each R_3 is H, R is not methyl.

35. The method of claim 34, wherein the amino acid is incorporated at a specific site into the polypeptide using a translation system comprising:

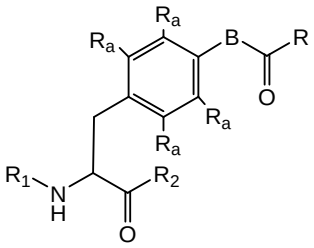
(i) a polynucleotide encoding the polypeptide, wherein the polynucleotide comprises a selector codon corresponding to the pre-designated site of incorporation of the amino acid of Formula (I), and

(ii) a tRNA comprising the amino acid, wherein the tRNA is specific to the selector codon.

36. The method of claim 35, wherein the translation system comprises a tRNA that is aminoacylated to the amino acid of Formula (I).

37. The method of claim 36, wherein the translation system is an *in vivo* translation system comprising a cell selected from the group consisting of a bacterial cell, archeaebacterial cell, and eukaryotic cell.

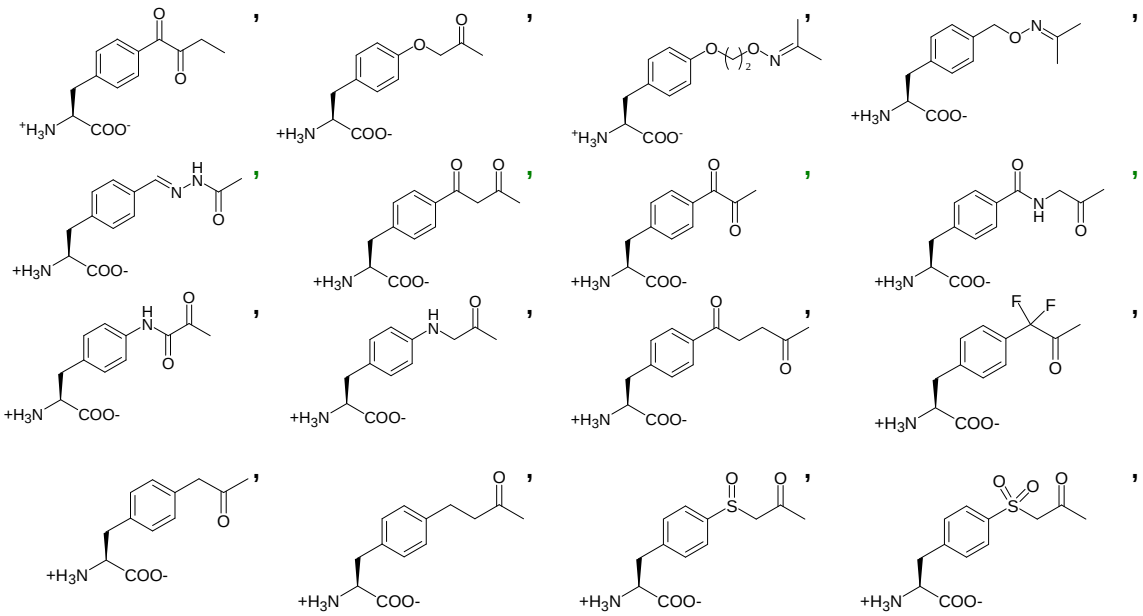
38. The method of claim 36, wherein the amino acid has a structure corresponding to Formula (III):

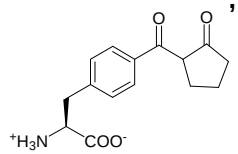
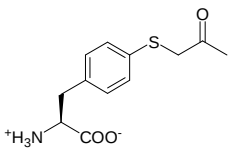
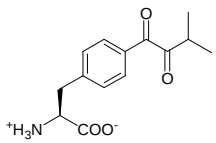
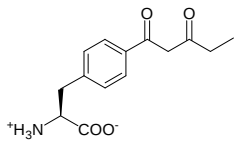
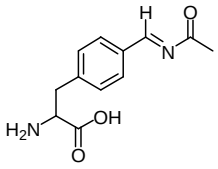


(III)

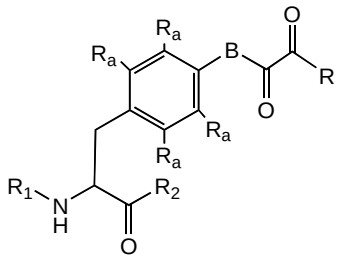
wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, -OR', and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

39. The method of claim 38, wherein the amino acid is selected from the group consisting of:




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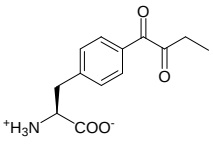
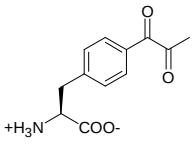
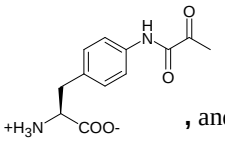
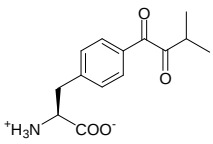
40. The method of claim 37, wherein the amino acid has a structure corresponding to Formula (VI):



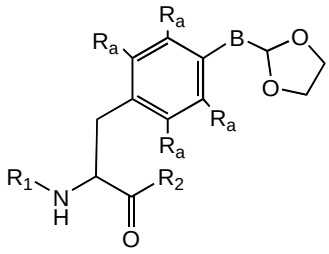
(VI)

wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, $-OR'$, and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

41. The method of claim 40, wherein the amino acid is selected from the group consisting of:


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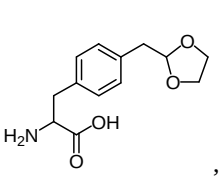
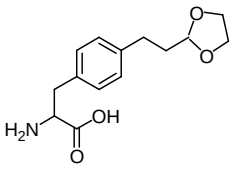
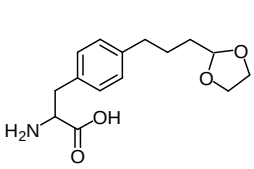
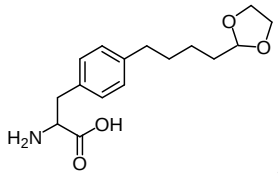
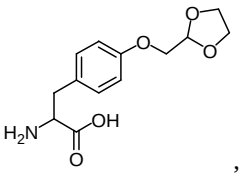
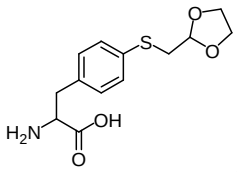
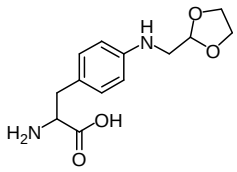
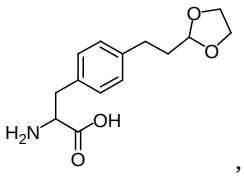
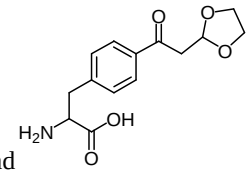
42. The method of claim 37, wherein the amino acid has a structure corresponding to Formula (IX):



(IX)

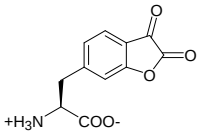
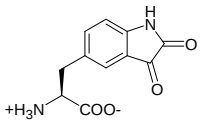
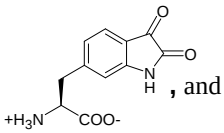
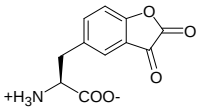
wherein each R_a is independently selected from the group consisting of H, halogen, alkyl, substituted alkyl, $-N(R')_2$, $-C(O)_kR'$ where k is 1, 2, or 3, $-C(O)N(R')_2$, $-OR'$, and $-S(O)_kR'$, where each R' is independently H, alkyl, or substituted alkyl.

43. The method of claim 42, wherein the amino acid is selected from the group consisting of:


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and .

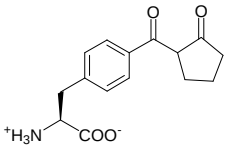
44. The method of claim 37, wherein the –A-B-J-R groups together form a bicyclic or tricyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group, protected carbonyl group, including a protected dicarbonyl group, or masked carbonyl group, including a masked dicarbonyl group.

45. The method of claim 44, wherein the amino acid is selected from the group consisting of:

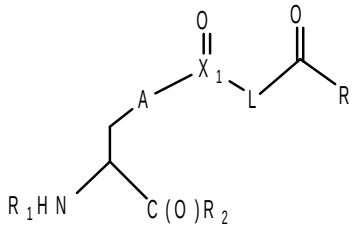

,

,

, and

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46. The method of claim 37, wherein the –J-R group together forms a monocyclic or bicyclic cycloalkyl or heterocycloalkyl comprising at least one carbonyl group, including a dicarbonyl group, protected carbonyl group, including a protected dicarbonyl group, or masked carbonyl group, including a masked dicarbonyl group.

47. The method of claim 46, wherein the amino acid is:

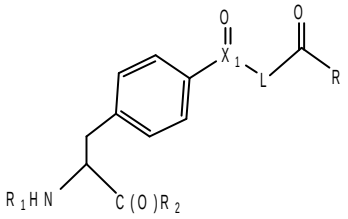

.

48. The method of claim 37, wherein the amino acid of Formula (I) has the structure of Formula (XXX):


(XXX);

wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

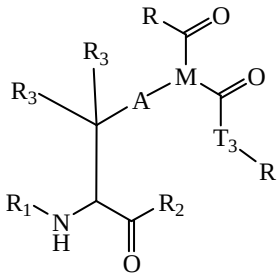
49. The method of claim 37, wherein the amino acid of Formula (I) has the structure of Formula (XXXIII):



(XXXIII);

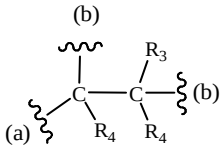
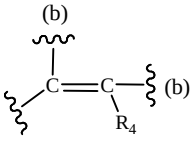
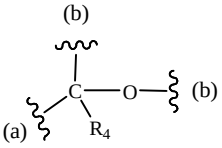
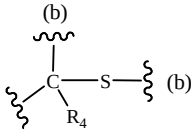
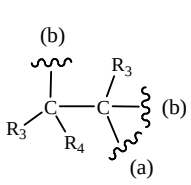
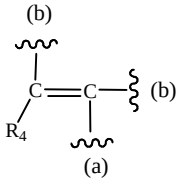
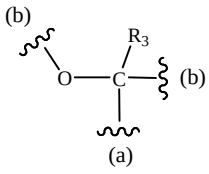
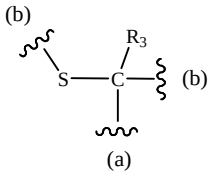
wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

50. The method of claim 37, corresponding to Formula (XXXX):

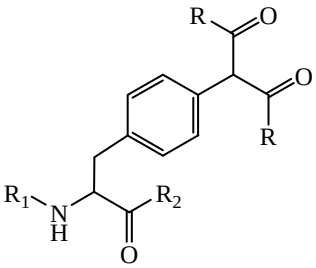


(XXXX)

wherein:

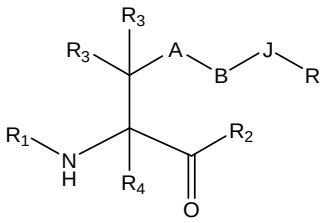
M is –C(R_3)-, , , , , , , , , or , where (a) indicates bonding to the A group and (b) indicates bonding to respective carbonyl groups; and T_3 is a bond, C(R)(R), O, or S, and R is H, halogen, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

51. The method of claim 50, corresponding to Formula (XXXXIII):



(XXXXIII).

52. A method for derivatizing a polypeptide comprising an amino acid of Formula (I), the method comprising contacting the polypeptide with a reagent of Formula (XIX), wherein Formula (I) corresponds to:

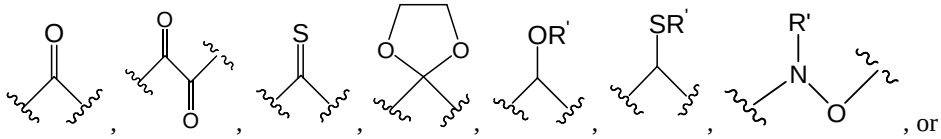
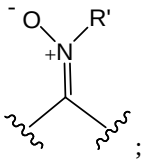


(I)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

J is , or ;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

each R' is independently H, alkyl, or substituted alkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl;

wherein Formula (XIX) corresponds to:



(XIX)

wherein:

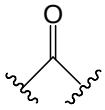
each X is independently a detectable label, biologically active agent, or polymer;

each L is a linker independently selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)NR'C(O)O-(alkylene or substituted alkylene)-, -O-CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -N(R')C(O)O-(alkylene or substituted alkylene)-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(O)N(R')-(alkylene or substituted alkylene)-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

L_1 is optional, and when present, is $-C(R')_p-NR'-C(O)O-$(alkylene or substituted alkylene)- where p is 0, 1, or 2;

W is $-ON(R_1)_2$ or $-C(=O)R_2$, where each R_1 is independently H or an amino protecting group, and R_2 is H or OR'; and

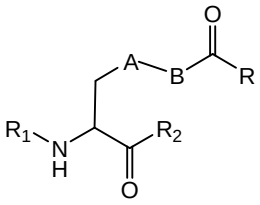
n is 1 to 3;

the method excluding contacting the polypeptide comprising an amino acid of Formula (I) with a reagent of Formula (XIX) wherein, in Formula (I), A is phenylene; B is a bond; J is 

; R is alkyl; R_1 is H, an amino protecting group, or at least one amino acid; R_2 is OH, an ester protecting group, or at least one amino acid; and R_3 and R_4 are H; and wherein, in Formula (XIX), X is a detectable label, wherein the detectable label is selected from a fluorescent, phosphorescent, chemiluminescent, chelating, intercalating, radioactive, and chromophoric moiety; and any combination thereof, or a polyalkylene glycol; L is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)NR'C(O)O-(alkylene or substituted alkylene)-, -O-CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -N(R')C(O)O-(alkylene or substituted alkylene)-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(O)N(R')-(alkylene or substituted alkylene)-,

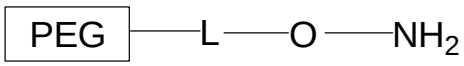
-N(R')C(S)N(R')-, -N(R')S(O)$_k$N(R')-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -C(R')$_2$-N=N-, and -C(R')$_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl; L_1 is optional, and when present, is –C(R')$_p$-NR'-C(O)O-(alkylene or substituted alkylene)- where p is 0, 1, or 2; W is –ON(R_1)$_2$, where each R_1 is independently H or an amino protecting group, and n is 1.

53. The method of claim 52, wherein the amino acid corresponds to Formula (II):



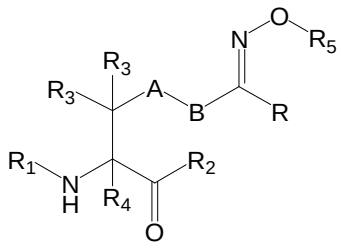
(II).

54. The method of claim 52, wherein the reagent corresponds to Formula (XXVII):



(XXVII).

55. The method of claim 52, wherein the derivatized polypeptide comprises at least one oxime containing amino acid having the structure of Formula (XI):



(XI)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, -S(O)$_k$- where k is 1, 2, or 3, -S(O)$_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -S(O)$_k$N(R')-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, -N(R')S(O)$_k$N(R')-, -N(R')-N=, -C(R')=N-,

-C(R')=N-N(R')-, -C(R')=N-N=, -C(R')$_2$-N=N-, and -C(R')$_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl;

R_5 is H, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, alkoxy, substituted alkoxy, alkylalkoxy, substituted alkylalkoxy, polyalkylene oxide, substituted polyalkylene oxide, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkaryl, substituted alkaryl, aralkyl, substituted aralkyl, -C(O)R", -C(O)$_2$R", or -C(O)N(R")$_2$, wherein each R" is independently hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkoxy, substituted alkoxy, aryl, substituted aryl, heteroaryl, alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl; or R_5 is L-X, where

X is a detectable label, biologically active agent, or polymer; and

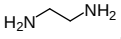
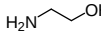
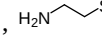
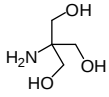
L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, -S(O)$_k$- where k is 1, 2, or 3, -S(O)$_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -S(O)$_k$N(R')-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, -N(R')S(O)$_k$N(R')-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -C(R')$_2$-N=N-, and -C(R')$_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

with a proviso that when A and B are absent, R is not methyl.

56. The method of claim 52, wherein the polypeptide is contacted with the reagent of Formula (XIX) in aqueous solution under mildly acidic conditions.

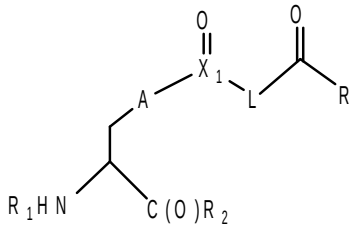
57. The method of claim 56, wherein the conditions are pH 2 to 8.

58. The method of claim 52, wherein the polypeptide is contacted with the reagent of Formula (XIX) in the presence of an accelerant selected from the group consisting of:

, , , , , , , , , , ,

and .

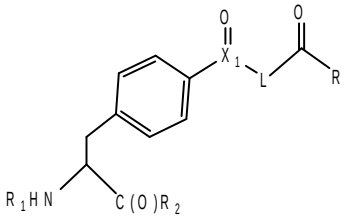
59. The method of claim 52, wherein the amino acid of Formula (I) has the structure of Formula (XXX):



(XXX);

wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

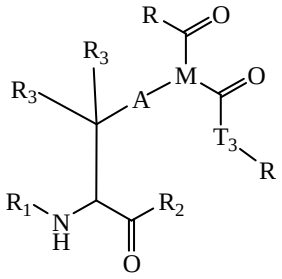
60. The method of claim 52, wherein the amino acid of Formula (I) has the structure of Formula (XXXIII):



(XXXIII);

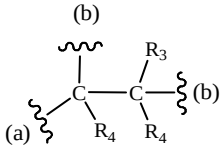
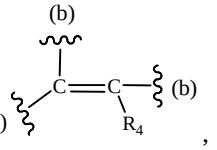
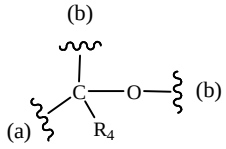
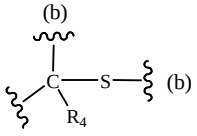
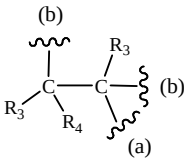
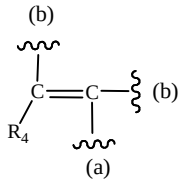
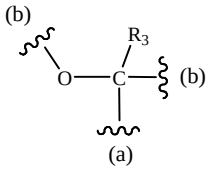
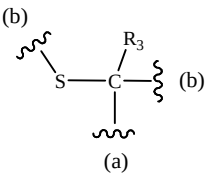
wherein X_1 is C, S, or S(O); and L is alkylene, substituted alkylene, N(R')(alkylene) or N(R')(substituted alkylene).

61. The method of claim 52, corresponding to Formula (XXXX):



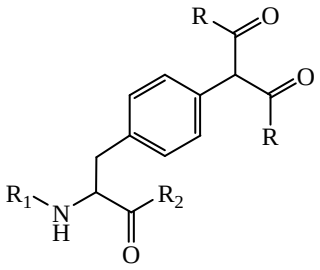
(XXXX)

wherein:

M is $-C(R_3)-$, , , , , , , , , or , where (a) indicates bonding to the A group and (b) indicates bonding to respective carbonyl groups; and

T_3 is a bond, C(R)(R), O, or S, and R is H, halogen, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

62. The method of claim 61, corresponding to Formula (XXXXIII):



(XXXXIII).

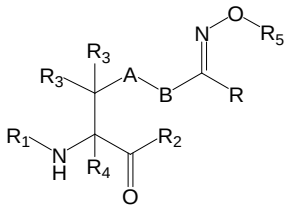
63. A method for treating a disorder, condition or disease, the method comprising administering a therapeutically effective amount of a non-natural amino acid polypeptide comprising at least one oxime-containing non-natural amino acid, wherein the oxime-containing non-natural amino acid is incorporated at a specific site within the polypeptide using a translation system comprising:

(i) a polynucleotide encoding the polypeptide, wherein the polynucleotide comprises a selector codon corresponding to the pre-designated site of incorporation of the oxime-containing amino acid, and

(ii) a tRNA comprising the oxime-containing amino acid, wherein the tRNA is specific to the selector codon.

64. The method of claim 63, wherein the translation system is an *in vivo* translation system comprising a cell selected from the following group of organisms: a prokaryote, a eukaryote, a mammal, an *Escherichia coli*, a fungi, a species of *Pseudomonas*, a yeast, an archaebacterium, a eubacterium, a plant, an insect, and a protist.

65. The method of claim 63, wherein the at least one non-natural amino acid is an oxime-containing amino acid and the oxime-containing non-natural amino acid has a structure corresponding to Formula (XI):



(XI)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted

alkylene)-, -$S(O)_k$- where k is 1, 2, or 3, -$S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -$S(O)_k$N(R')-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, -N(R')$S(O)_k$N(R')-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -$C(R')_2$-N=N-, and -$C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

R_5 is H, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, alkoxy, substituted alkoxy, alkylalkoxy, substituted alkylalkoxy, polyalkylene oxide, substituted polyalkylene oxide, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkaryl, substituted alkaryl, aralkyl, substituted aralkyl, -(alkylene or substituted alkylene)-$ON(R")_2$, -(alkylene or substituted alkylene)-C(O)SR", -(alkylene or substituted alkylene)-S-S-(aryl or substituted aryl), -C(O)R", -$C(O)_2$R", or -C(O)$N(R")_2$, wherein each R" is independently hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkoxy, substituted alkoxy, aryl, substituted aryl, heteroaryl, alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl;

or R_5 is L-X, where

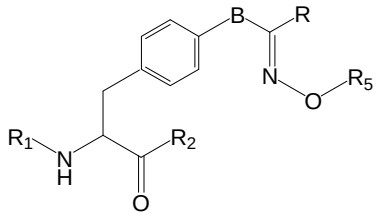
X is a selected from the group consisting of a label; a dye; a polymer; a water-soluble polymer; a derivative of polyethylene glycol; a photocrosslinker; a cytotoxic compound; a drug; an affinity label; a photoaffinity label; a reactive compound; a resin; a second protein or polypeptide or polypeptide analog; an antibody or antibody fragment; a metal chelator; a cofactor; a fatty acid; a carbohydrate; a polynucleotide; a DNA; a RNA; an antisense polynucleotide; a saccharide, a water-soluble dendrimer, a cyclodextrin, a biomaterial; a nanoparticle; a spin label; a fluorophore, a metal-containing moiety; a radioactive moiety; a novel functional group; a group that covalently or noncovalently interacts with other molecules; a photocaged moiety; a photoisomerizable moiety; biotin; a biotin analogue; a moiety incorporating a heavy atom; a chemically cleavable group; a photocleavable group; an elongated side chain; a carbon-linked sugar; a redox-active agent; an amino thioacid; a toxic moiety; an isotopically labeled moiety; a biophysical probe; a phosphorescent group; a chemiluminescent group; an electron dense group; a magnetic group; an intercalating group; a chromophore; an energy transfer agent; a biologically active agent; a detectable label; and any combination of the above; and

L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or

substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, -$S(O)_k$- where k is 1, 2, or 3, -$S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -(alkylene or substituted alkylene)-O-N=CR'-, -(alkylene or substituted alkylene)-C(O)NR'-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-$S(O)_k$-(alkylene or substituted alkylene)-S-, -(alkylene or substituted alkylene)-S-S-, -$S(O)_k$N(R')-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, -N(R')$S(O)_k$N(R')-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -$C(R')_2$-N=N-, and -$C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

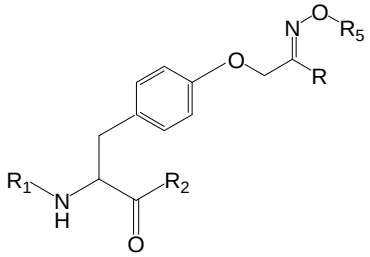
with a proviso that when A and B are absent, R is not methyl.

66. The method of claim 65, wherein the oxime-containing amino acid has a structure corresponding to Formula (XII):



(XII).

67. The method of claim 65, wherein the oxime-containing amino acid has a structure corresponding to Formula (XIII):



(XIII).

68. The method of claim 65, wherein X is a water-soluble polymer.

69. The method of claim 65, wherein X is a derivative of polyethylene glycol.

70. The method of claim 65, wherein X is a cytotoxic compound.

71. The method of claim 65, wherein X is a drug.

72. The method of claim 65, wherein X is a second polypeptide.

73. The method of claim 72, wherein the second polypeptide is an oxime-containing non-natural amino acid polypeptide.

74. The method of claim 72, wherein the second polypeptide has the same amino acid structure as the non-natural amino acid polypeptide of claim 62.

75. The methods of any of claims 63, further comprising a pharmaceutically acceptable carrier.

76. The method of claim 63, wherein the oxime-containing non-natural amino acid polypeptide is a modified oxime-containing non-natural amino acid polypeptide.

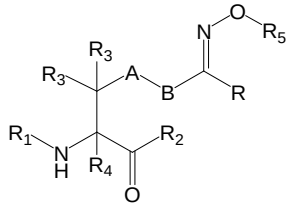
77. A method for detecting the presence of a polypeptide in a patient, the method comprising administering an effective amount of a homologous non-natural amino acid polypeptide comprising at least one oxime-containing non-natural amino acid, wherein the oxime-containing amino acid is incorporated at a specific site within the polypeptide using a translation system comprising:

(i) a polynucleotide encoding the polypeptide, wherein the polynucleotide comprises a selector codon corresponding to the pre-designated site of incorporation of the oxime-containing amino acid, and

(ii) a tRNA comprising the oxime-containing amino acid, wherein the tRNA is specific to the selector codon.

78. The method of claim 77, wherein the translation system is an *in vivo* translation system comprising a cell selected from the following group of organisms: a prokaryote, a eukaryote, a mammal, an *Escherichia coli*, a species of *Pseudomonas*, a fungi, a yeast, an archaebacterium, a eubacterium, a plant, an insect, and a protist.

79. The method of claim 77, wherein the oxime-containing non-natural amino acid polypeptide comprises at least one oxime-containing amino acid having a structure of Formula (XI):



(XI)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or

substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')$-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')$-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2$-N=N-, and $-C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

R_5 is H, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, alkoxy, substituted alkoxy, alkylalkoxy, substituted alkylalkoxy, polyalkylene oxide, substituted polyalkylene oxide, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkaryl, substituted alkaryl, aralkyl, substituted aralkyl, -(alkylene or substituted alkylene)-$ON(R")_2$, -(alkylene or substituted alkylene)-C(O)SR", -(alkylene or substituted alkylene)-S-S-(aryl or substituted aryl), -C(O)R", $-C(O)_2R"$, or $-C(O)N(R")_2$, wherein each R" is independently hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkoxy, substituted alkoxy, aryl, substituted aryl, heteroaryl, alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl;

or R_5 is L-X, where

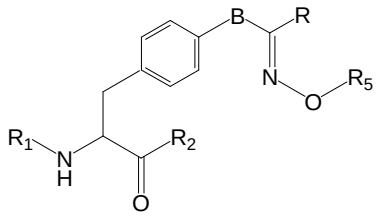
X is a selected from the group consisting of a label; a dye; a polymer; a water-soluble polymer; a derivative of polyethylene glycol; a photocrosslinker; a cytotoxic compound; a drug; an affinity label; a photoaffinity label; a reactive compound; a resin; a second protein or polypeptide or polypeptide analog; an antibody or antibody fragment; a metal chelator; a cofactor; a fatty acid; a carbohydrate; a polynucleotide; a DNA; a RNA; an antisense polynucleotide; a saccharide, a water-soluble dendrimer, a cyclodextrin, a biomaterial; a nanoparticle; a spin label; a fluorophore, a metal-containing moiety; a radioactive moiety; a novel functional group; a group that covalently or noncovalently interacts with other molecules; a photocaged moiety; a photoisomerizable moiety; biotin; a biotin analogue; a moiety incorporating a heavy atom; a chemically cleavable group; a photocleavable group; an elongated side chain; a carbon-linked sugar; a redox-active agent; an amino thioacid; a toxic moiety; an isotopically labeled moiety; a biophysical probe; a phosphorescent group; a chemiluminescent group; an electron dense group; a magnetic group; an intercalating group; a chromophore; an energy transfer agent; a biologically active agent; a detectable label; and any combination of the above; and

L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k$- where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or

substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -(alkylene or substituted alkylene)-O-N=CR'-, -(alkylene or substituted alkylene)-C(O)NR'-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-$S(O)_k$-(alkylene or substituted alkylene)-S-, -(alkylene or substituted alkylene)-S-S-, -$S(O)_k$N(R')-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, -N(R')$S(O)_k$N(R')-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, -$C(R')_2$-N=N-, and -$C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

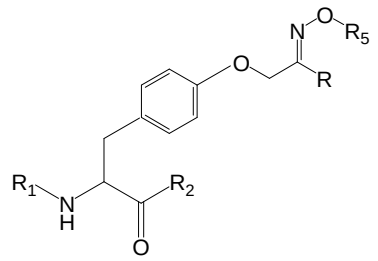
with a proviso that when A and B are absent, R is not methyl.

80. The method of claim 79, wherein the oxime-containing amino acid has a structure corresponding to Formula (XII):



(XII).

81. The method of claim 79, wherein the oxime-containing amino acid has a structure corresponding to Formula (XIII):



(XIII).

82. The method of claim 79, wherein X is selected from the group consisting of a label; a dye; an affinity label; a photoaffinity label; a spin label; a fluorophore; a radioactive moiety; a moiety incorporating a heavy atom; an isotopically labeled moiety; a biophysical probe; a phosphorescent group; a chemiluminescent group; an electron dense group; a magnetic group; a chromophore; an energy transfer agent; a detectable label; and any combination of the above.

83. The method of claim 79, wherein the biosynthetic oxime-containing non-natural amino acid polypeptide is a modified biosynthetic oxime-containing non-natural amino acid polypeptide.

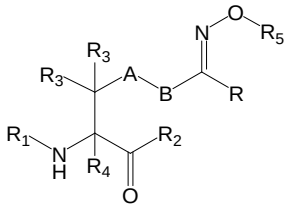
84. A method for easing the isolation properties of a polypeptide comprising utilizing a homologous non-natural amino acid polypeptide comprising at least one oxime-containing non-natural amino acid, wherein the oxime-containing amino acid is incorporated at a specific site within the polypeptide using a translation system comprising:

(i) a polynucleotide encoding the polypeptide, wherein the polynucleotide comprises a selector codon corresponding to the pre-designated site of incorporation of the oxime-containing amino acid, and

(ii) a tRNA comprising the oxime-containing amino acid, wherein the tRNA is specific to the selector codon.

85. The method of claim 84, wherein the translation system is an *in vivo* translation system comprising a cell selected from the following group of organisms: a prokaryote, a eukaryote, a mammal, an *Escherichia coli*, a fungi, a species of *Pseudomonas*, a yeast, an archaebacterium, a eubacterium, a plant, an insect, and a protist.

86. The method of claim 84, wherein the oxime-containing non-natural amino acid polypeptide comprises at least oxime-containing one amino acid having a structure of Formula (XI):



(XI)

wherein:

A is optional, and when present is lower alkylene, substituted lower alkylene, lower cycloalkylene, substituted lower cycloalkylene, lower alkenylene, substituted lower alkenylene, alkynylene, lower heteroalkylene, substituted heteroalkylene, lower heterocycloalkylene, substituted lower heterocycloalkylene, arylene, substituted arylene, heteroarylene, substituted heteroarylene, alkarylene, substituted alkarylene, aralkylene, or substituted aralkylene;

B is optional, and when present is a linker selected from the group consisting of lower alkylene, substituted lower alkylene, lower alkenylene, substituted lower alkenylene, lower heteroalkylene, substituted lower heteroalkylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k-$ where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, $-S(O)_kN(R')-$, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')-$, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2-N=N-$, and $-C(R')_2-N(R')-N(R')-$, where each R' is independently H, alkyl, or substituted alkyl;

R is H, alkyl, substituted alkyl, cycloalkyl, or substituted cycloalkyl;

R_1 is H, an amino protecting group, resin, amino acid, polypeptide, or polynucleotide; and

R_2 is OH, an ester protecting group, resin, amino acid, polypeptide, or polynucleotide;

each of R_3 and R_4 is independently H, halogen, lower alkyl, or substituted lower alkyl, or R_3 and R_4 or two R_3 groups optionally form a cycloalkyl or a heterocycloalkyl;

R_5 is H, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, alkoxy, substituted alkoxy, alkylalkoxy, substituted alkylalkoxy, polyalkylene oxide, substituted polyalkylene oxide, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkaryl, substituted alkaryl, aralkyl, substituted aralkyl, -(alkylene or substituted alkylene)-$ON(R")_2$, -(alkylene or substituted alkylene)-C(O)SR", -(alkylene or substituted alkylene)-S-S-(aryl or substituted aryl), -C(O)R", $-C(O)_2R$", or $-C(O)N(R")_2$, wherein each R" is independently hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkoxy, substituted alkoxy, aryl, substituted aryl, heteroaryl, alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl;

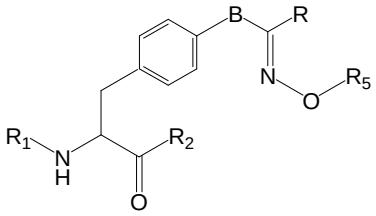
or R_5 is L-X, where

X is a selected from the group consisting of a label; a dye; a polymer; a water-soluble polymer; a derivative of polyethylene glycol; a photocrosslinker; a cytotoxic compound; a drug; an affinity label; a photoaffinity label; a reactive compound; a resin; a second protein or polypeptide or polypeptide analog; an antibody or antibody fragment; a metal chelator; a cofactor; a fatty acid; a carbohydrate; a polynucleotide; a DNA; a RNA; an antisense polynucleotide; a saccharide, a water-soluble dendrimer, a cyclodextrin, a biomaterial; a nanoparticle; a spin label; a fluorophore, a metal-containing moiety; a radioactive moiety; a novel functional group; a group that covalently or noncovalently interacts with other molecules; a photocaged moiety; a photoisomerizable moiety; biotin; a biotin analogue; a moiety incorporating a heavy atom; a chemically cleavable group; a photocleavable group; an elongated side chain; a carbon-linked sugar; a redox-active agent; an amino thioacid; a toxic moiety; an isotopically labeled moiety; a biophysical probe; a phosphorescent group; a chemiluminescent group; an electron dense group; a magnetic group; an intercalating group; a chromophore; an energy transfer agent; a biologically active agent; a detectable label; and any combination of the above; and

L is optional, and when present is a linker selected from the group consisting of alkylene, substituted alkylene, alkenylene, substituted alkenylene, -O-, -O-(alkylene or substituted alkylene)-, -S-, -S-(alkylene or substituted alkylene)-, $-S(O)_k$- where k is 1, 2, or 3, $-S(O)_k$(alkylene or substituted alkylene)-, -C(O)-, -C(O)-(alkylene or substituted alkylene)-, -C(S)-, -C(S)-(alkylene or substituted alkylene)-, -N(R')-, -NR'-(alkylene or substituted alkylene)-, -C(O)N(R')-, -CON(R')-(alkylene or substituted alkylene)-, -CSN(R')-, -CSN(R')-(alkylene or substituted alkylene)-, -N(R')CO-(alkylene or substituted alkylene)-, -N(R')C(O)O-, -(alkylene or substituted alkylene)-O-N=CR'-, -(alkylene or substituted alkylene)-C(O)NR'-(alkylene or substituted alkylene)-, -(alkylene or substituted alkylene)-$S(O)_k$-(alkylene or substituted alkylene)-S-, -(alkylene or substituted alkylene)-S-S-, $-S(O)_kN(R')$-, -N(R')C(O)N(R')-, -N(R')C(S)N(R')-, $-N(R')S(O)_kN(R')$-, -N(R')-N=, -C(R')=N-, -C(R')=N-N(R')-, -C(R')=N-N=, $-C(R')_2$-N=N-, and $-C(R')_2$-N(R')-N(R')-, where each R' is independently H, alkyl, or substituted alkyl;

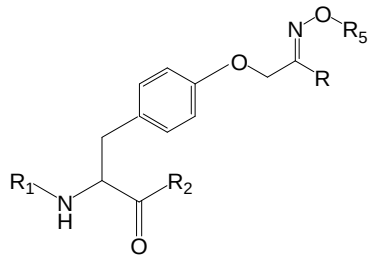
with a proviso that when A and B are absent, R is not methyl.

87. The method of claim 84, wherein the oxime-containing amino acid has a structure corresponding to Formula (XII):



(XII).

88. The method of claim 87, wherein the oxime-containing amino acid has a structure corresponding to Formula (XIII):



(XIII).

89. The method of claim 87, wherein X is a water-soluble polymer.

90. The method of claim 87, wherein X is a derivative of polyethylene glycol.

91. The method of claim 79, wherein the oxime-containing non-natural amino acid polypeptide is a modified oxime-containing non-natural amino acid polypeptide.