

CLAIMS

WHAT IS CLAIMED IS:

1. A method for processing a peptide, comprising:
 - (a) providing the peptide comprising a terminal amino acid, wherein the peptide is coupled to a barcode molecule;
 - (b) contacting a Barcode Transfer Reagent (BTR) comprising an additional barcode molecule with the terminal amino acid or a terminal amino acid derivative, thereby generating a barcoded-amino acid complex (BTR-AC);
 - (c) coupling the additional barcode molecule of the BTR to the barcode molecule that is coupled to the peptide; and
 - (d) cleaving the terminal amino acid or the terminal amino acid derivative, wherein subsequent to the cleaving, the terminal amino acid or the terminal amino acid derivative is coupled to the barcode molecule that is coupled to the peptide.
2. The method of claim 1, wherein the BTR comprises a chemical moiety that reacts with an amino acid.
3. The method of claim 1, wherein the chemical moiety reacts with an N-terminal amino acid.
4. The method of claim 1, wherein the chemical moiety comprises dinitrofluorobenzene, dansyl chloride, thiocyanate, or an isothiocyanate.
5. The method of claim 4, wherein the chemical moiety is the isothiocyanate, and wherein the isothiocyanate is selected from the group consisting of phenyl isothiocyanate (PITC), 3-pyridyl isothiocyanate (PYITC), 2-piperidinoethyl isothiocyanate (PEITC), 3-(4-morpholino)propyl isothiocyanate (MPITC), 3 (diethylamino)propyl isothiocyanate (DEPTIC), naphthylisothiocyanate (NITC), trimethylsilyl isothiocyanate (TMS-ITC), and acetyl isothiocyanate (AITC).
6. The method of claim 1, wherein the barcode molecule or the additional barcode molecule is a nucleic acid barcode molecule.
7. The method of claim 1, wherein the coupling of (c) comprises directly coupling the additional barcode molecule of the BTR to the barcode molecule that is coupled to the peptide.
8. The method of claim 7, wherein the directly coupling comprises coupling via a click chemistry reaction.

9. The method of claim 7, wherein the directly coupling comprises coupling via ligation.
10. The method of claim 1, wherein the coupling of (c) comprises performing a polymerase extension reaction.
11. The method of claim 1, wherein the cleaving of (d) comprises a chemical cleavage.
12. The method of claim 11, wherein the chemical cleavage comprises an acidic cleavage or a basic cleavage.
13. The method of claim 1, wherein the cleaving of (d) comprises an enzymatic cleavage.
14. The method of claim 1, further comprising, (e) contacting the cleaved terminal amino acid or terminal amino acid derivative with a binding agent.
15. The method of claim 14, wherein the binding agent is specific to the amino acid residue or derivatized amino acid.
16. The method of claim 14, wherein the binding agent comprises an antibody, antibody fragment, single chain variant fragment, nanobody, tRNA synthetase, or aptamer.
17. The method of claim 14, wherein the binding agent comprises a nucleic acid barcode molecule; and further comprising, coupling the nucleic acid barcode molecule to the BTR.
18. The method of claim 17, wherein the nucleic acid barcode molecule identifies the binding agent.
19. The method of claim 17, wherein the coupling comprises performing a polymerase extension reaction.
20. The method of claim 14, wherein the binding agent comprises a fluorophore.
21. The method of claim 20, further comprising detecting the binding agent using single molecule imaging.
22. The method of claim 1, wherein the peptide is affixed to a substrate.
23. The method of claim 22, wherein the substrate is a bead, a glass surface, a silicon surface, a plastic surface, a filter, a membrane, a silicon wafer chip, a flow through chip, a flow cell, a biochip, a microtiter well, an ELISA plate, a spinning interferometry disc, a nitrocellulose-based polymer surface, a polymer matrix, a nanoparticle, or a microsphere.
24. The method of claim 1, further comprising, subsequent to (d), detecting the cleaved terminal amino acid or terminal amino acid derivative.

25. The method of claim 24, wherein the detecting comprises using a nanopore to identify the terminal amino acid.
26. The method of claim 1, further comprising, repeating (b)-(d).
27. The method of claim 26, wherein the additional barcode molecule of the BTR comprises cycle information.
28. The method of claim 1, wherein the barcode molecule coupled to the peptide identifies the peptide or the sample, partition, or cell from where the peptide originated.
29. The method of claim 1, wherein the peptide is from a cell suspension, culture of cells, tissue sample, bodily fluid, or an environmental sample.
30. The method of claim 1, wherein the barcode molecule is coupled to the peptide at a C-terminal amino acid.