## CLAIMS

1. A polypeptide comprising an amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 440, wherein a detectable bioluminescent signal is produced in the presence of a substrate when the polypeptide contacts a peptide consisting of SEQ ID NO: 2.

2. The polypeptide of claim 1, wherein the polypeptide exhibits enhancement of one or more traits compared to a polypeptide of SEQ ID NO: 440, wherein the traits are selected from: affinity for the peptide consisting of SEQ ID NO: 2, expression, intracellular solubility, intracellular stability, and bioluminescent activity when combined with the peptide consisting of SEQ ID NO: 2.

3. The polypeptide of claim 1, wherein the amino acid sequence is selected from one of the polypeptide sequences of Table 2.

4. The polypeptide of claim 1, wherein the detectable bioluminescent signal is produced in the presence of a substrate when the polypeptide associates with the peptide consisting of SEQ ID NO: 2.

5. The polypeptide of claim 1, wherein the amino acid sequence is synthetic, contains non-natural amino acids or is a peptide mimic.

6. A nucleic acid comprising a sequence coding for a polypeptide of claim 1.

7. A fusion polypeptide comprising the polypeptide of claim 1 and a first interaction polypeptide that is configured to form a complex with a second interaction polypeptide upon contact of the first interaction polypeptide and the second interaction polypeptide.

8. A bioluminescent complex comprising:

(a) the fusion polypeptide of claim 7; and

(b) a second fusion polypeptide comprising:

i) the second interaction polypeptide, and

ii) a complement peptide that causes the polypeptide comprising an amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 2 to emit a detectable bioluminescent signal in the presence of a substrate when an association is formed between the two;

wherein the first fusion polypeptide and second fusion polypeptide are associated;

and wherein the polypeptide comprising an amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 440 and the complement peptide are associated.

9. A bioluminescent complex comprising:

(a) a peptide comprising a peptide amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 2; and

(b) a polypeptide comprising a polypeptide amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 440, wherein the bioluminescent complex exhibits detectable luminescence.

10. The bioluminescent complex of claim 9, wherein the peptide amino acid sequence and the polypeptide amino acid sequence are associated.

11. The bioluminescent complex of claim 10, wherein the peptide amino acid sequence is attached to a first interaction element that is associated with a second interaction element.

12. The bioluminescent complex of claim 11, wherein the polypeptide amino acid sequence is attached to the second interaction element.

13. The bioluminescent complex of claim 12, wherein the polypeptide amino acid sequence and peptide amino acid sequence are incapable of associating in the absence of the association of the first and second interaction elements.

14. A bioluminescent complex comprising:

(a) a first amino acid sequence that is not a fragment of a preexisting protein; and

(b) a second amino acid sequence that is not a fragment of a preexisting protein, wherein the bioluminescent complex exhibits detectable luminescence, wherein the first amino acid sequence and the second amino acid sequence are associated, and wherein the bioluminescent complex emits a detectable bioluminescent signal in the presence of a substrate when the first amino acid sequence and the second amino acid sequence are associated.

15. The bioluminescent complex of claim 14, further comprising:

(c) a third amino acid sequence comprising a first member of an interaction pair, wherein the third amino acid sequence is covalently attached to the first amino acid sequence; and

(d) a fourth amino acid sequence comprising a second member of an interaction pair, wherein the fourth amino acid sequence is covalently attached to the second amino acid sequence.

16. The bioluminescent complex of claim 15, wherein the non-covalent interactions between the first amino acid sequence and the second amino acid sequence are not sufficient to associate the first amino acid sequence and the second amino acid sequence in the absence of the non-covalent interactions between the first member and the second member of the interaction pair.

17. The bioluminescent complex of claim 15, wherein a first polypeptide chain comprises the first amino acid sequence and the third amino acid sequence, and wherein a second polypeptide chain comprises the second amino acid sequence and the fourth amino acid sequence.

18. The bioluminescent complex of claim 17, wherein the first polypeptide chain and the second polypeptide chain are expressed within a cell.

19. A bioluminescent complex comprising:

(a) a non-luminescent pair, wherein each non-luminescent element of the non-luminescent pair is not a fragment of a preexisting protein;

(b) an interaction pair, wherein each interaction element of the interaction pair is covalently attached to one of the non-luminescent elements of the non-luminescent pair.

20. A method of detecting a stable interaction between a first amino acid sequence and a second amino acid sequence comprising:

(a) attaching the first amino acid sequence to a third amino acid sequence, and attaching the second amino acid sequence to a fourth amino acid sequence, wherein the third and fourth amino acid sequences are not fragments of a preexisting protein, wherein a stable complex of the third and fourth amino acid sequences emits a detectable bioluminescent signal in the presence of a substrate, wherein the non-covalent interactions between the third and fourth amino acid sequences are insufficient to form a complex of the third and fourth amino acid sequences in the absence of additional stabilizing and/or aggregating forces, and wherein a stable interaction between the first amino acid sequence and the second amino acid sequence provides the additional stabilizing and/or aggregating forces to produce a stable complex of the third and fourth amino acid sequences;

(b) placing the first, second, third, and fourth amino acid sequences of step (a) in conditions to allow for stable interactions between the first amino acid sequence and the second amino acid sequence to occur; and

(c) detecting the bioluminescent signal emitted, in the presence of a substrate, by the stable complex of the third and fourth amino acid sequences in the presence of a substrate, wherein detection of the bioluminescent signal indicates a stable interaction between the first amino acid sequence and the second amino acid sequence.

21. The method of claim 20, wherein attaching the first amino acid sequence to the third amino acid sequence and the second amino acid sequence to the fourth amino acid sequence comprises forming a first fusion protein comprising the first amino acid sequence and the third amino acid sequence and forming a second fusion protein comprising the second amino acid sequence and the fourth amino acid sequence.

22. The method of claim 21, wherein the first fusion protein and the second fusion protein further comprise linkers between said first and third amino acid sequences and said second and fourth amino acid sequences, respectively.

23. The method of claim 21, wherein the first fusion protein is expressed from a first nucleic acid sequence coding for the first and third amino acid sequences, and the second fusion protein is expressed from a second nucleic acid sequence coding for the second and fourth amino acid sequences.

24. The method of claim 23, wherein a single vector comprises the first nucleic acid sequence and the second nucleic acid sequence.

25. The method of claim 23, wherein the first nucleic acid sequence and the second nucleic acid sequence are on separate vectors.

26. The method of claim 23, wherein steps (a) and (b) comprise expressing the first and second fusion proteins within a cell.

27. A method of optimizing a non-luminescent pair comprising:

(a) aligning the sequences of three or more related proteins;

(b) determining a consensus sequence for the related proteins;

(c) providing first and second fragments of a protein related to three or more proteins, wherein the fragments are individually substantially non-luminescent but exhibit luminescence upon stable interaction of the fragments;

(d) mutating the first and second fragments at one or more positions each, wherein said mutations alter the sequences of the fragments to be more similar to a corresponding portion of the consensus sequence, wherein the mutating results in a non-luminescent pair that are not fragments of a preexisting protein,

(e) testing the non-luminescent pair for the absence of luminescence when unassociated and luminescence upon stable association of the non-luminescent pair.

28. The method of claim 27, wherein the non-luminescent pair exhibits enhancement of one or more traits compared to the first and second fragments, wherein the traits are selected from: increased reconstitution affinity, decreased reconstitution affinity, enhanced expression, increased intracellular solubility, increased intracellular stability, and increased intensity of reconstituted luminescence.

29. A detection reagent comprising: (a) a polypeptide comprising an amino acid sequence having less than 100% and greater than 40% sequence identity with SEQ ID NO: 440, wherein a detectable bioluminescent signal is produced, in the presence of a substrate, when the polypeptide contacts a peptide consisting of SEQ ID NO: 2, and (b) a substrate for a bioluminescent complex produced by said polypeptide and a peptide consisting of SEQ ID NO: 2.