

Claims:

1. A method for producing a bacterial microcompartment virus-like particle (VLP) carrying a cargo molecule, said method comprising
 introducing into a host cell or organism one or more heterologous polynucleotides comprising
 - (i) a first sequence encoding bacterial microcompartment shell protomers, which are CsoS1A and CsoS4A from *Halothiobacillus neapolitanus*; and
 - (ii) a second sequence encoding a cargo molecule fused to an encapsulation peptide, wherein the encapsulation peptide comprises the amino acid sequence set forth in SEQ ID NO: 1 (SKITGSSGNDTQGSLITYSGGARG) ;
 - a) expressing the first and second sequences; and
 - b) forming a microcompartment that encapsulates the cargo molecule.
2. The method of claim 1, wherein CsoS1A comprises an amino acid set forth in SEQ ID NO: 2 and CsoS4A comprises an amino acid sequence set forth in SEQ ID NO: 3.
3. The method of claim 1 or 2, wherein the cargo molecule is at least one peptide, such as an enzyme and/or fluorescent protein and/or immunogenic peptide.
4. The method of any one of claims 1 to 3, wherein the expression of CsoS1A is controlled by promoter P_{T7}; CsoS4A is controlled by promoter P_{CON5}.
5. The method of any one of claims 1 to 4, wherein the host organism is *E. coli*.
6. An engineered bacterial microcompartment VLP carrying a cargo molecule, comprising bacterial microcompartment shell protomers, and a cargo molecule fused to an encapsulation peptide, wherein the encapsulation peptide comprises the amino acid sequence set forth in SEQ ID NO: 1, wherein the bacterial microcompartment protomers are CsoS1A and CsoS4A from *Halothiobacillus neapolitanus*.
7. The engineered VLP of claim 6, wherein CsoS1A comprises the amino acid sequence set forth in SEQ ID NO: 2 and CsoS4A comprises the amino acid sequence set forth in SEQ ID NO: 3.
8. The engineered VLP of claim 6 or 7, wherein the cargo molecule is at least one peptide, such as an enzyme and/or fluorescent protein and/or immunogenic peptide.

9. An isolated plasmid or vector nucleic acid comprising:

a) a first DNA sequence that encodes bacterial microcompartment shell protomers which are CsoS1A and CsoS4A from *Halothiobacillus neapolitanus*, each of which is operably linked to a promoter, and

b) a second DNA sequence that encodes a cargo molecule fused to an encapsulation peptide, operably linked to a promoter, wherein the encapsulation peptide comprises the amino acid sequence set forth in SEQ ID NO: 1.

10. The isolated plasmid or vector of claim 9, wherein the bacterial microcompartment shell protomers, promoters, and cargo molecules are as defined in any one of claims 1 to 4.

11. The isolated plasmid or vector of claim 10, wherein the DNA sequences encoding said bacterial microcompartment shell protomers, cargo molecules and tags have at least 70%, at least 80%, at least 90%, or 100% identity with SEQ ID Nos 7-12 and 95 due to redundancy of the genetic code.

12. A composition or combination comprising at least one engineered VLP of claims 6 to 8 for use in:

a) the prophylaxis or treatment of disease in a subject; or

b) a biochemical process.

13. The composition or combination of claim 12, wherein the at least one engineered VLP comprises an enzyme for conversion of a prodrug.

14. The combination of claim 12 or 13, comprising one or more additional therapeutic agents.

15. The composition or combination of claim 12 or 14, which is a vaccine.