Claims

1. An adeno associated virus (AAV) particle comprising a chemically functionalized capsid protein, wherein the chemically functionalized capsid protein comprises at least one ligand binding site, and

wherein the ligand binding site comprises a dibenzocyclooctyne group or an azide group, and

wherein the ligand binding site is covalently attached to an ε-amino group or a primary amine of a lysine residue of the capsid protein.

2. The AAV particle of claim 1 further comprising a ligand that is attached to the ligand binding site.

3. The AAV particle of claim 1 or 2, wherein the attachment between the ligand binding site and the ligand comprises bioorthogonal crosslinkers.

4. The AAV particle of any one of claims 1-3, wherein the ligand binding site comprises a dibenzocyclooctyne group and the ligand comprises an azide group.

5. The AAV particle of any one of claims 1-3, wherein the ligand binding site comprises an azide group and the ligand comprises a dibenzocyclooctyne group.

6. The AAV particle of any one of claims 1-3, wherein the ligand is attached to the ligand binding site via a Staudinger reaction or a strain-promoted click reaction.

7. The AAV particle of any one of claims 1-6, wherein the modified capsid protein is selected from one or more of VP1, VP2 and VP3.

8. The AAV particle of any one of claims 1-7, wherein the AAV particle has a higher infectivity rate at lower titers compared to an unmodified AAV particle of the same serotype.

9. The AAV particle of any one of claims 1-8, wherein the chemically functionalized capsid protein is further modified to remove a natural mammalian cell binding site.

10. The AAV particle of claim 9, wherein the natural mammalian cell binding site is a heparan sulfate proteoglycan binding site.

11. The AAV particle of any one of claims 1-10, wherein the AAV particle has a modified tropism compared to an unmodified AAV particle of the same serotype.

12. The AAV particle according to any one of claims 2-11, wherein the ligand is selected from a protein ligand, a toxin subunit, a lectin, an adhesion factor, an antibody, a peptide, and a gene editing nuclease.

13. A method of producing an adeno associated virus (AAV) particle comprising a chemically functionalized capsid protein, the method comprising the steps of:

covalently attaching at least one ligand binding site to an ε-amino group or a primary amine of a lysine residue of the capsid protein, the ligand binding site comprising an azide group or a dibenzocyclooctyne group; and

attaching a ligand to at least one ligand binding site of the capsid protein.

14. The method according to claim 13, wherein the ligand is attached to the ligand binding site via a product of a Staudinger reaction or a strain-promoted click reaction.

15. The method according to claim 13 or 14 further comprising the step of modifying the capsid to remove a natural mammalian cell binding site.

16. A pharmaceutical composition comprising the AAV particle according to any one of claims 1-12, a transgene, and at least one pharmaceutically acceptable carrier and/or diluent.

17. The pharmaceutical composition according to claim 16 for use in treating a disease that can be treated by gene therapy selected from cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.

18. The AAV particle according to any one of claims 1-12 and a transgene for use in treating a disease that can be treated by gene therapy selected from cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.

19. Use of the AAV particle according to any one of claims 1-12 for the transfection of a cell *in vitro*.

20. Use of the AAV particle according to any one of claims 1-12 and a transgene in the manufacture of a medicament for treating a disease that can be treated by gene therapy selected from cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.