Claims

1. An adeno associated virus (rAAV) 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 rAAV particle of claim 1, further comprising a ligand that is attached to the ligand binding site.

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

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

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

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

12. The rAAV 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 an enzyme, such as 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 rAAV particle according to any one of claims 1-12, and at least one pharmaceutically acceptable carrier and/or diluent.

17. The rAAV particle according to any one of claims 1-12 or the pharmaceutical composition according to claim 16, for use in gene therapy, such as gene therapy treatment of cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.

18. The rAAV particle according to any one of claims 1-12 or the pharmaceutical composition according to claim 16, for use in treating a patient having a genetic abnormality, the use comprising administering the rAAV particle according to any one of claims 1-12 or the pharmaceutical composition according to claim 16 to a subject in need thereof, wherein said genetic abnormality is one that can be treated by gene therapy.

19. The rAAV particle of claim 18, wherein the genetic abnormality is selected from cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.

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

21. Use of the rAAV particle according to any one of claims 1-12 in the manufacture of a medicament for treating a patient having a genetic abnormality that can be treated by gene therapy.

22. The use of claim 21, wherein the genetic abnormality is selected from cancer, an inherited monogenic disease, a genetic skin disease, an infectious disease, type I diabetes, and wound healing.