CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A composition, comprising:

a solid nanoparticle core functionalized with:

at least one RNA molecule attached to the solid nanoparticle core by a first linker,

at least one cell penetrating peptide (CPP) attached to the solid nanoparticle core; and

at least one positively charged moiety linked to the solid nanoparticle core;

wherein the functionalized nanoparticle is substantially neutrally charged, negatively or positively charged.

2. The composition of claim 1, wherein the solid nanoparticle core is metallic or non-metallic.

3. The composition of claim 1 or claim 2, wherein the nanoparticle core is superparamagnetic.

4. The composition of claim 2, wherein the solid nanoparticle core comprises iron, gold, or other metals as described above.

5. The composition of one of claims 1-4, wherein the solid nanoparticle core has a size of 50 nm or less in diameter.

6. The composition of claim 1, wherein the RNA molecule is an uncapped mRNA molecule with a 5' end and a 3' end, wherein the 5' end of the uncapped mRNA molecule is covalently bound to the first linker.

7. The composition of claim 1, wherein the RNA molecule is a capped mRNA molecule with a 5' end and a 3' end, wherein the 3' end is of the capped mRNA molecule is covalently bound to the first linker.

8. The composition of claim 6 or claim 7, wherein the mRNA molecule is at least about 150 nucleotides in length.

9. The composition of claim 6 or claim 7, wherein the mRNA molecule encodes an antigen of interest.

10. The composition of claim 6 or claim 7, wherein the mRNA molecule encodes an enzyme of interest.

11. The composition of claim 10, wherein the mRNA molecule encodes a telomerase.

12. The composition of claim 6 or claim 7, wherein the mRNA molecule encodes the detectable protein marker.

13. The composition of claim 1, wherein the first linker is a linear linker.

14. The composition of claim 1, wherein the first linker is a branching linker with a single point of contact to the solid nanoparticle core and a plurality of branches, wherein at least two of the plurality of branches are attached to individual RNA molecules.

15. The composition of claim 1, wherein the first linker is at least 6 ångstroms long.

16. The composition of claim 1, wherein the first linker is a cleavable linker.

17. The composition of claim 16, wherein the cleavable linker is configured to be cleaved within a cell.

18. The composition of claim 16 or claim 17, wherein the cleavable linker comprises a disulfide bond.

19. The composition of one of claims 16-18, wherein the cleavable linker is acid labile or other types of linker.

20. The composition of claim 1, wherein the at least one CPP is attached to the solid nanoparticle core by a second linker, wherein the first linker and the second linker are the same or different.

21. The composition of claim 20, wherein the first linker and second linker are different, and the second linker is longer than the first linker.

22. The composition of claim 1, wherein the at least one positively charged moiety is attached to the solid nanoparticle core by a third linker, wherein the first linker and the third linker are the same or different.

23. The composition of claim 22, wherein the first linker and third linker are different, and the third linker is longer than the first linker.

24. The composition of claim 1, when the at least one positively charged moiety is a charged peptide.

25. The composition of claim 24, wherein the charged peptide contains two or more positively charged amino acids.

26. The composition of any preceding claim, wherein the solid nanoparticle core has a plurality of mRNA or siRNA molecules and a plurality of positively charged moieties attached thereto at a ratio of about 100:1 to about 1:10.

27. The composition of claims 1, wherein the composition comprises at least two mRNA molecules attached to the solid nanoparticle core, wherein the mRNA molecules can be the same or different, and wherein at least one of the mRNA molecules is an uncapped mRNA molecule with a 5' end and a 3' end, wherein the 5' end of the uncapped mRNA molecule is covalently bound to the first linker.

28. The composition of claim 1, wherein the at least one CPP comprises five to nine basic amino acids.

29. The composition of claim 28, wherein the at least one CPP comprises five to nine contiguous basic amino acids.

30. The composition of claim 1, further comprising at least one siRNA molecule attached to the solid nanoparticle core, wherein the at least one siRNA molecule is specific for a gene of interest.

31. The composition of claim 30, further comprising a two or more different siRNA molecules attached to the solid nanopore core, wherein each of the two or more siRNA molecules are specific to different genes of interest or different sequences in a gene of interest.

32. The composition of claim 30 or claim 31, wherein the siRNA molecules and RNA molecules are present in a ratio of about 1:20 to about 20:1.

33. A cell comprising the functionalized nanoparticle recited in one of claims 1-32.

34. A method of expressing a polypeptide of interest in a cell, comprising delivering the composition as recited in any of claims 1-32 to the cell and permitting expression of the RNA molecule, wherein the RNA molecule encodes the polypeptide of interest.

35. The method of claim 34, wherein the polypeptide is an antigen.

36. The method of claim 34, wherein the polypeptide is an enzyme.

37. The method of claim 36, wherein the enzyme is a telomerase.

38. The method of claim 34, wherein the polypeptide is a detectable marker or a structural protein.