CLAIMS

1. A gene expression system comprising
(a) a vector that comprises in a 5' to 3' orientation a bacteriophage promoter, a first capping sequence, an alphavirus replicon operatively linked to the bacteriophage promoter, a subgenomic promoter, a second capping sequence, and a gene of interest, and
(b) a protein that comprises an exogenous RNA polymerase which transcribes the alphavirus replicon, wherein the exogenous RNA polymerase is co-delivered with the alphavirus vector into a cell, and wherein the gene of interest is expressed in the cytoplasm of the cell.

2. The gene expression system of claim 1, wherein the alphavirus replicon is from an alphavirus selected from the group consisting of Sindbis virus (SIN), Semliki Forest virus (SFV), and Venezuelan equine encephalitis virus (VEE).

3. The gene expression system of claim 1, wherein the alphavirus replicon is noncytopathic.

4. The gene expression system of claim 3, wherein the alphavirus replicon has one or more mutations in the nsp2 subunit.

5. The gene expression system of claim 1, wherein the bacteriophage promoter is selected from the group consisting of T7, T3, and SP6 promoters.

6. The gene expression system of claim 1, wherein both the first and second capping sequences are the internal ribosome entry site sequence from encephalomyocarditis virus.

7. The gene expression system of claim 1, wherein the gene of interest encodes for an antigen.

8. The gene expression system of claim 7, wherein the antigen is selected from the group consisting of a viral antigen, a bacterial antigen, and a cancer antigen.

9. The gene expression system of claim 1, wherein the subgenomic promoter is from an alphavirus.

10. The gene expression system of claim 1, wherein the bacteriophage promoter is T7 promoter and the exogenous RNA polymerase is T7 RNA polymerase.

11. A method for producing an induced pluripotent stem cell, comprising:
(a) introducing into a mammalian somatic cell a gene expression system to produce a transduced somatic cell, wherein the gene expression system comprises

(i) a vector comprising a sequence that encodes one or more mammalian reprogramming factor, and

(ii) a protein that comprises an exogenous RNA polymerase co-delivered with the alphavirus vector, and

(b) culturing the transduced somatic cell in the presence of a cytokine on a fibroblast feeder layer or an extracellular matrix under a condition for maintaining pluripotency and self-renewal.

12. The method of claim 11, wherein the sequence encodes reprogramming factors Oct 3/4, Sox2, Klf4, and c-Myc, wherein the four reprogramming factors are expressed simultaneously.

13. The method of claim 11 or 12, wherein culturing the transduced somatic cell is carried out in the presence of a substance for improving the efficiency of establishing the pluripotent stem cell.

14. The method of claim 13, wherein the substance for improving the efficiency of establishing the pluripotent stem cell is selected from the group consisting of a histone deacetylase (HDAC) inhibitor, a histone methyltransferase (G9a) inhibitor, and a DNA methylase (Dnmt) inhibitor.

15. A vaccine comprising the gene expression system of any one of claims 1-10, wherein the gene of interest encodes an antigen.

16. The vaccine of claim 15, wherein the antigen is selected from the group consisting of a viral antigen, a bacterial antigen, and a cancer antigen.

17. The vaccine of claim 16, wherein the antigen is influenza hemagglutinin (HA).

18. A therapeutic composition, comprising a dendritic cell transfected with the gene expression system of any one of claims 1-10, wherein the gene of interest encodes an antigen capable of being displayed on the surface of the dendritic cell, wherein the therapeutic composition is capable of producing an immune response in a subject.

19. The therapeutic composition of claim 18, wherein the antigen is a tumor antigen.

20. The therapeutic composition of claim 19, wherein the tumor antigen is one or more proteins selected from the group consisting of tyrosinase, tyrosine-related protein 1 (TRP-1), and tyrosine-related protein 2 (TRP-2).

21. Use of a therapeutic composition comprising a dendritic cell transfected with the gene expression system of any one of claims 1-10 in the manufacture of a medicament for the treatment of cancer, wherein the gene of interest encodes an antigen capable of being displayed on the surface of the dendritic cell, wherein the antigen is a tumor antigen.

22. The use of claim 21, wherein the cancer is melanoma, and the antigen is tyrosinase.

23. The use of claim 21, wherein the cancer is melanoma, and the antigen is tyrosine-related protein 1 (TRP-1).

24. The use of claim 21, wherein the cancer is melanoma, and the antigen is tyrosine-related protein 2 (TRP-2).

25. A therapeutic composition, for use in the treatment of cancer wherein the therapeutic composition comprises a dendritic cell transfected with the gene expression system of any one of claims 1-10, wherein the gene of interest encodes an antigen capable of being displayed on the surface of the dendritic cell, and wherein the antigen is a tumor antigen, and the composition is capable of producing an immune response in a subject.

26. The therapeutic composition of claim 25, wherein the cancer is melanoma, and the antigen is tyrosinase.

27. The therapeutic composition of claim 25, wherein the cancer is melanoma, and the antigen is tyrosine-related protein 1 (TRP-1).

28. The therapeutic composition of claim 25, wherein the cancer is melanoma, and the antigen is tyrosine-related protein 2 (TRP-2).