CLAIMS

1. An in vitro method of activating T cells, comprising:

incubating in the presence of a magnetic field a population of T cells and a nano-scale artificial antigen presenting cell (nano-aAPC), the nano-aAPC comprising:

a paramagnetic nanoparticle;

at least one T cell costimulatory molecule on the surface of the nanoparticle; and

at least one major histocompatibility complex comprising at least one antigen binding cleft, wherein an antigenic peptide is bound to the antigen binding cleft,

thereby activating antigen-specific T cells.

2. The method of claim 1, wherein the nanoparticle is from 25 to 500 nm in diameter.

3. The method of claim 1 or 2, wherein the population of T cells is incubated in the presence of a magnetic field for 10 minutes to 3 days.

4. The method of any one of claims 1 to 3, further comprising separating antigen-specific T cells from cells that are not bound to the nano-aAPC using magnetic enrichment.

5. The method of any one of claims 1 to 4, wherein the peptide antigen is a tumor-associated antigen.

6. The method of any one of claims 1 to 5, wherein the T cell costimulatory molecule is an antibody that specifically binds to CD28.

7. The method of any one of claims 1 to 6, wherein the activated T cells are cytotoxic T cells.

8. The method of any one of claims 1 to 7, wherein the population of T cells is obtained from peripheral blood mononuclear cells, bone marrow, lymph node tissue, spleen tissue, or tumor tissue, and wherein optionally the population of T cells is obtained by apheresis or leukapheresis.

9. The method of any one of claims 1 to 8, wherein the population of T cells is incubated with the nano-aAPCs for 3 to 21 days.

10. The method of any one of claims 1 to 8, wherein the population of T cells is incubated with the nano-aAPCs for 7 to 10 days.

11. The method of any one of claims 1 to 10, wherein the major histocompatibility complex comprises a first and second MHC Class I α chain each fused to an immunoglobulin heavy chain.

12. The method of any one of claims 1 to 10, wherein the major histocompatibility complex comprises two first fusion proteins comprising (i) an immunoglobulin heavy chain and (ii) an extracellular domain of an MHC Class IIβ chain, and two second fusion proteins comprising (i) an immunoglobulin K or λ light chain and (ii) an extracellular domain of an MHC class II α chain.

13. The method of claim 1, wherein the antigenic peptide is a tumor-associated antigen, a peptide of an autoantigen, a peptide of an alloantigen, or a peptide of an infectious agent antigen.

14. The method of claim 1, wherein the T cell costimulatory molecule is CD80 (B7-1), CD86 (B7-2), B7-H3, 4-lBBL, CD27, CD30, CD134 (OX-40L), B7h (B7RP-1), CD40, LIGHT, an antibody that specifically binds to CD28, an antibody that specifically binds to HVEM, an antibody that specifically binds to CD40L, an antibody that specifically binds to OX40, and an antibody that specifically binds to 4-1BB.