CLAIMS

1. A method for preparing an antigen-specific T-cell population, comprising:
providing a sample comprising T-cells from a patient or a suitable donor;
contacting said sample with a population of first particles which are paramagnetic and comprise on their surfaces an MHC-peptide antigen-presenting complex, wherein the particles are from about 10 to about 500 nm in diameter;
placing a magnetic field in proximity to the paramagnetic particles; and
recovering antigen-specific T-cells associated with the magnetic particles.
2. The method of claim 1, wherein the antigen-specific T cells are cytotoxic T lymphocytes, helper T cells, or regulatory T cells.
3. The method of claim 1, wherein the antigen-specific T cells are CD8+ cytotoxic T lymphocytes.
4. The method of claim 3, wherein the T-cells are from a patient and the patient is a cancer patient, wherein optionally: (a) the cancer is a solid tumor; (b) the cancer is melanoma, colon cancer, duodenal cancer, prostate cancer, breast cancer, ovarian cancer, ductal cancer, hepatic cancer, pancreatic cancer, renal cancer, endometrial cancer, testicular cancer, stomach cancer, dysplastic oral mucosa, polyposis, head and neck cancer, invasive oral cancer, non-small-cell lung carcinoma, small-cell lung cancer, mesothelioma, transitional and squamous cell urinary carcinoma, brain cancer, neuroblastoma, or glioma; (c) the cancer is a hematological malignancy; (d) the antigen-presenting complex presents a tumor associated antigen; (e) the antigen-presenting complex presents a neoantigen predicted from genetic analysis of the patient's tumor, wherein the neoantigen is formed by a mutation selected from the group consisting of a passenger mutation, a driver mutation, an oncogene forming mutation, and a tumor suppressor destroying mutation; or (f) the antigen-presenting complex presents an antigen predicted from genetic analysis of the patient's tumor, wherein optionally the antigen is for use in vaccinating the patient.
5. The method of claim 1, wherein:

(1) the antigen-specific T cells are CD8+ cytotoxic T lymphocytes and/or CD4+ helper T cells, wherein optionally the T cells are from a patient and the patient has an infectious disease;

(2) the T cells are regulatory T cells, and wherein the patient has an autoimmune disease;

(3) the sample comprising T cells is selected from a group consisting of: a peripheral blood mononuclear cell (PBMC) sample, memory T cells, naïve T cells, previously activated T cells, and tumor infiltrating lymphocytes;

(4) the sample comprising T cells is from bone marrow, lymph node tissue, spleen tissue, or a tumor;

(5) the sample is enriched for CD8+ cells, CD4+ cells, or T regulatory cells, wherein optionally the sample is enriched for CD8+antigen-specific T cells by placing the cells in a magnetic field.

6. The method of any one of claims 1 to 5, wherein the sample comprising T cells is from a suitable donor who is HLA-matched to an adoptive transfer recipient, wherein the recovered antigen-specific T-cells are for adoptive transfer to the recipient.

7. The method of any one of claims 1 to 6, wherein the paramagnetic particles comprising on their surface an MHC-peptide antigen-presenting complex further comprise a lymphocyte costimulatory ligand, wherein optionally:

(a) the antigen-specific T-cells express one or more activation markers;

(b) the paramagnetic particles comprise at least 5 MHC-peptide antigen-presenting complexes on their surface; or

(c) wherein the paramagnetic particles comprise at least 5 lymphocyte costimulatory ligand molecules on their surface.

8. The method of claim 7, wherein the antigen presenting complex is dimeric, and wherein the complex comprises a fusion of MHC with immunoglobulin heavy chain sequences associated by disulfide bonds, wherein optionally:

(a) the immunoglobulin sequences are IgG sequences;

(b) the MHC is an HLA-A2; or

(c) the immunoglobulin sequences are humanized monoclonal antibody sequences.

9. The method of claim 7, wherein the lymphocyte costimulatory ligand is one or more selected from the group consisting of: an antibody or antigen-binding fragment thereof that specifically binds to CD28, CD80 (B7-1), CD86 (B7-2), B7-H3, 4-1BBL, 4-1BB, CD27, CD30, CD134 (OX-40L), B7h (B7RP-1), CD40, LIGHT, an antibody or antigen-binding fragment thereof that specifically binds to HVEM, an antibody or antigen-binding fragment thereof that specifically binds to CD40L, an antibody or antigen binding fragment thereof

that specifically binds to OX40, and an antibody or antigen-binding fragment thereof that specifically binds to 4-1BB.

10. The method of any one of claims 7 to 9, wherein the co-stimulatory ligand is a humanized murine monoclonal antibody or fully human antibody against CD28, wherein optionally the co-stimulatory ligand is a humanized monoclonal antibody 9.3 or antigen-binding fragment thereof.

11. The method of any one of claims 1 to 10, wherein:

(1) from about 3 to about 10 different antigens are presented by the antigen presenting complexes in the population of paramagnetic particles;

(2) the recovered antigen-specific T-cells are enriched for antigen-specific, naïve T cells; and/or

(3) wherein at least about 10^6, or at least about 10^7 antigen specific T cells are obtained, and wherein optionally said at least about 10^6, or at least about 10^7 antigen-specific T cells are for administration to a patient recipient as adoptive immunotherapy, wherein preferably the sample comprises T cells from a suitable donor who is HLA-mismatched to an adoptive transfer recipient, wherein the recovered antigen-specific T-cells are for adoptive transfer to the recipient.

12. A method for identifying a T cell antigen or component of a T cell repertoire, comprising:

providing a sample comprising T cells from a subject,

screening the isolated T cells against a library of paramagnetic particles each comprising on their surface an MHC-peptide antigen-presenting complex, wherein the particles are from about 10 to about 500 nm in diameter, wherein each particle presents a candidate peptide antigen, and

identifying one or more peptide antigens that cause activation of the subject's T cells.

13. The method of claim 12, wherein:

(1) the subject is a cancer patient, and wherein optionally the candidate peptides comprise peptide antigen's predicted from genetic analysis of the patient's cancer;

(2) activation of the subject's T cells is identified by cytokine expression, which is optionally measured by immunochemistry or RT-PCR, or activation of the subject's T cells is identified by measuring intracellular signaling indicative of T cell activation, wherein optionally: (a) selected peptide

antigens are loaded onto artificial antigen presenting cells for administration to the patient; or (b) T cells that recognize the identified antigens are enriched and expanded *ex vivo* for administration to the subject;

(3) the subject is suspected of having an immune disease, and the paramagnetic particles present a library of candidate peptides indicative of autoimmune and/or immune disease; or

(4) the subject is suspected of having an infectious disease, and the paramagnetic particles,present a library of candidate peptides indicative of infectious diseases.

14. The antigen-specific T-cell population obtained by the method of any one of claims 1 to 13 for use in therapy by injection.

15. The method of any one of claims 1 to 11, wherein the paramagnetic particles comprise on their surface an MHC-peptide antigen-presenting complex, and further contacting the sample with second particles comprising a lymphocyte costimulatory ligand.