CLAIMS:

1. A method for producing a cell composition comprising CD8+ cytotoxic T lymphocytes (CTLs) specific for one or more cancer-associated peptide antigens for adoptive immunotherapy, comprising:

providing a sample of T cells from whole blood or buffy coat fraction, bone marrow, lymph node tissue, spleen tissue, or tumor;

depleting the sample of CD4+ T cells;

expanding the CD4+ depleted cells ex vivo in the presence of cytokines consisting of IL-2, IL-4, IL-6, INF-γ, and IL-1β, and in the presence of artificial Antigen Presenting Cells (aAPCs) presenting one or more cancer-associated peptide antigens through association with HLA ligands, the aAPCs further presenting T lymphocyte co-stimulatory ligands;

wherein after expansion, the CD8+ T cells in the composition are predominately central memory (Tcm) and effector memory (TEM) phenotype, and comprise T memory stem cells; and at least 15% of the T cells in the composition are specific for the cancer-associated peptide antigen.

2. The method of claim 1, wherein the CD4+ depleted cells are expanded in the presence of a population of artificial Antigen Presenting Cells (aAPCs) comprising HLA ligands presenting from 1 to 10 cancer-associated peptide antigens.

3. The method of claim 2, wherein the population of aAPCs comprise HLA ligands presenting at least 3 cancer-associated peptide antigens.

4. The method of claim 2, wherein the aAPCs comprise a paramagnetic core, and the population of cells are activated in the presence of a magnetic field for a duration of from 2 to 30 minutes.

5. The method of claim 4, wherein the population of CD4+ depleted cells are enriched for T cells specific for said cancer-associated peptide antigens by magnetic enrichment with the paramagnetic aAPCs.

6. The method of claim 1, wherein the T lymphocyte co-stimulatory ligands are CD28 agonists.

7. The method of claim 1, wherein said cancer-associated peptide antigens are associated with acute myelogenous leukemia or multiple myeloma.

8. The method of claim 7, wherein said cancer-associated peptide antigens comprise epitopes derived from one or more of SURVIVIN, WT-1, PRAME, RHAMM, PR3, and CYCLIN A1.

9. The method of claim 7, wherein said cancer-associated peptide antigens comprise epitopes derived from one or more of NY-ESO-1, WT-1, SOX-2, CD138, CS1, XBP1-US, and XBP1-SP.

10. The method of claim 1, wherein the cell composition has at least 70% central and effector memory T cells.

11. The method of claim 10, wherein the cell composition has at least 80% central and effector memory T cells.

12. The method of claim 1, wherein the cell composition has less than 10% terminally differentiated T cells.

13. The method of claim 1, wherein the cell composition has less than 5% naive cells.

14. The method of claim 1, wherein the cell composition has from 1% to 25% T memory stem cells.

15. The method of claim 1, wherein at least 30% of the CD8+ T cells in the composition are specific for the cancer-associated peptide antigens.

16. The method of claim 1, wherein at least 50% of the CD8+ T cells in the composition are specific for the cancer-associated peptide antigens.

17. The method of claim 1, wherein the cell composition further comprises γδT cells.

18. The method of claim 1, wherein the cell composition comprises at least 10% γδT cells.

19. The method of claim 1, wherein the cell composition comprises at least 10^7 CD8+ T cells specific for the cancer-associated peptide antigens.

20. The method of claim 1, wherein the population of cells is expanded in culture for from 1 to 4 weeks.

21. The method of claim 20, wherein the population of cells is expanded in culture for about 2 weeks.