Claims

1. A modified immune cell, wherein the modified immune cell comprises a T cell receptor (TCR) targeting HPV E7 antigen and a chimeric switch receptor, wherein the TCR comprises a TCR α chain variable domain and a TCR β chain variable domain; wherein the amino acid sequence of αCDR3 of the TCR α chain variable domain is shown as SEQ ID NO: 3, or a variant thereof in which one or two amino acids are substituted with other amino acids; and the amino acid sequence of βCDR3 of the TCR β chain variable domain is shown as SEQ ID NO: 6, or a variant thereof in which one or two amino acids are substituted with other amino acids.

2. The modified immune cell of claim 1, wherein the TCR α chain variable domain comprises complementarity-determining regions αCDR1, αCDR2 and αCDR3, and the TCR β chain variable domain comprises complementarity-determining regions βCDR1, βCDR2 and βCDR3, wherein:

αCDR1, αCDR2 and αCDR3 are shown as SEQ ID NO: 1, SEQ ID NO: 2 and SEQ ID NO: 3 respectively, and βCDR1, βCDR2 and βCDR3 are shown as SEQ ID NO: 4, SEQ ID NO: 5 and SEQ ID NO: 6 respectively; or CDR variants thereof in which one or two amino acids in one or more CDRs are substituted with other amino acids.

3. The modified immune cell of claim 1, wherein the modified immune cell expresses the following elements:

A. a T cell receptor (TCR), which specifically targets HPV E7 antigen peptide;

preferably, the TCR is capable of binding to HPV E7 antigen peptide presented by HLA-A*02; more preferably, the TCR is capable of binding to HPV E7 antigen peptide presented by HLA-A*02:01; further preferably, the peptide comprises the amino acid sequence YMLDLQPET or YILDLQPET;

and

B. a chimeric switch receptor, which comprises an extracellular domain (ECD), a transmembrane region (TM) and an intracellular domain (ICD), wherein the ECD is selected from ECDs of immunosuppressive molecules, and the ICD is selected from ICDs of co-stimulatory molecules; wherein binding of the ECD of the

immunosuppressive protein to its immunosuppressive factor or ligand generates an activating signal rather than an inhibitory signal in the modified immune cell.

4. A nucleic acid molecule, wherein the nucleic acid molecule comprises a nucleic acid sequence encoding the TCR in claim 1.

5. The nucleic acid molecule of claim 4, wherein the nucleic acid molecule further comprises a nucleic acid sequence encoding the chimeric switch receptor in claim 3.

6. A vector, wherein the vector comprises the nucleic acid molecule of claim 4 or claim 5.

7. A pharmaceutical composition, wherein the composition comprises a pharmaceutically acceptable carrier and the modified immune cell in any one of claims 1 to 3, the nucleic acid molecule in claim 4 or 5, or the vector in claim 6.

8. Use of the modified immune cell in any one of claims 1 to 3, the nucleic acid molecule of claim 4 or 5, the vector in claim 6, or the pharmaceutical composition of claim 7 in the manufacture of a medicament for preventing or treating diseases associated with HPV infection, wherein the HPV infection-associated diseases include one or more malignant tumors induced by human papillomavirus (HPV), selected from the group consisting of cervical cancer, oropharyngeal cancer, head and neck cancer, vaginal cancer, vulvar cancer, penile cancer and anal cancer.

9. A T cell receptor targeting HPV E7 antigen or a fragment thereof, wherein the T cell receptor or fragment thereof comprises a TCR α chain variable domain and a TCR β chain variable domain selected from the following group:

(1) the TCR α chain variable domain comprises the following three CDRs: αCDR1 shown as SEQ ID NO: 1, αCDR2 shown as SEQ ID NO: 2, and αCDR3 shown as SEQ ID NO: 3, or a variant of the foregoing CDRs with substitution of 1 or 2 amino acids therein; and

(2) the TCR β chain variable domain comprises the following three CDRs: βCDR1 shown as SEQ ID NO: 4, βCDR2 shown as SEQ ID NO: 5, and βCDR3 shown as SEQ ID NO: 6, or a variant of the foregoing CDRs with substitution of 1 or 2 amino acids therein.

10. A nucleic acid molecule, wherein the nucleic acid molecule comprises a nucleic acid sequence encoding the T cell receptor or fragment in claim 9, or a complementary sequence thereof.

11. A vector, wherein the vector comprises the nucleic acid molecule of claim 10, wherein the vector is selected from plasmids, binary vectors, DNA vectors, mRNA vectors, retroviral vectors, lentiviral vectors, transposon-based vectors and artificial chromosomes.

12. An isolated polypeptide encoded by the nucleic acid molecule of claim 10 or the vector of claim 11.

13. An isolated cell, wherein the cell contains the T cell receptor or fragment thereof in claim 9, the nucleic acid molecule of claim 10, the vector of claim 11 or the polypeptide of claim 12; preferably, the cell comprises an amino acid sequence shown as SEQ ID NO: 13.

14. A pharmaceutical composition, wherein the composition comprises a pharmaceutically acceptable carrier and the T cell receptor or fragment thereof in claim 9, the nucleic acid molecule of claim 10, the vector of claim 11, the polypeptide of claim 12, or the cell of claim 13.

15. Use of the T cell receptor or fragment thereof in claims 9, the nucleic acid molecule of claim 10, the vector of claim 11, the polypeptide of claim 12, the cell of claim 13, or the pharmaceutical composition of claim 14 in the manufacture of a medicament for preventing or treating diseases associated with HPV infection, wherein the HPV infection-associated diseases include one or more malignant tumors induced by human papillomavirus (HPV), selected from the group consisting of cervical cancer, oropharyngeal cancer, head and neck cancer, vaginal cancer, vulvar cancer, penile cancer and anal cancer.