

WHAT IS CLAIMED IS:

1. An anti-human BCMA single-chain variable fragment (scFv), comprising:
a heavy chain variable region (V_H) having the amino acid of SEQ ID NO: 3; and
a light chain variable region (V_L) having the amino acid of SEQ ID NO: 5.
2. The scFv of claim 1, further comprising a linker in between the V_H and the V_L.
3. The scFv of Claim 2, wherein the linker has the amino acid sequence of SEQ ID NO: 4.
4. An anti-BCMA chimeric antigen receptor (CAR) comprising:
an anti-BCMA single-chain variable fragment (scFv) comprising
a heavy chain variable region (V_H) having the amino acid of SEQ ID NO: 3; and
a light chain variable region (V_L) having the amino acid of SEQ ID NO: 5.
a transmembrane domain;
a co-stimulatory domain; and
an activating domain.
5. The CAR of Claim 4, wherein the transmembrane domain is a transmembrane domain selected from the group consisting of a T cell receptor α chain, a T cell receptor β chain, a CD3 zeta chain, a CD28, a CD3 ϵ , a CD45, a CD4, a CD5, a CD8, a CD9, a CD16, a CD22, a CD33, a CD37, a CD64, a CD80, a CD86, a CD134, a CD137, an ICOS, a CD154, and a GITR, optionally wherein the transmembrane domain comprises a transmembrane domain of a CD8.
6. The CAR of Claim 4, wherein the co-stimulatory domain is a co-stimulatory domain selected from the group consisting of a CD28, a 4-1BB, a GITR, an ICOS-1, a CD27, an OX-40, and a DAP10, optionally wherein the co-stimulatory domain comprises a 4-1BB co-stimulatory domain.
7. The CAR of Claim 4, wherein the activation domain comprises a CD3 zeta activating domain.

8. The CAR of Claim 4, having the amino acid sequence of SEQ ID NO: 17.
9. A nucleic acid, having a 5' end and a 3' end, encoding the CAR of claim 4.
10. A vector, comprising the nucleic acid of Claim 9.
11. The vector of Claim 10, wherein the vector is a virus vector.
12. An isolated CAR-T cell, comprising the CAR of Claim 4 or Claim 8.
13. Use of a humanized CAR-T cell in the preparation of a medicament for the treatment of a BCMA-positive cancer in a patient in need thereof, the humanized CAR-T cell comprising an anti-BCMA chimeric antigen receptor (CAR) comprising:
 - an anti-BCMA single-chain variable fragment (scFv) comprising
 - a heavy chain variable region (V_H) having the amino acid sequence of SEQ ID NO: 3, and
 - a light chain variable region (V_L) having the amino acid sequence of SEQ ID NO: 5;
 - a transmembrane domain;
 - a co-stimulatory domain; and
 - an activating domain.
14. The use of Claim 13, wherein the medicament is formulated for intra-tumoral administration.
15. The use of Claim 13, wherein the BCMA-positive cancer cells comprise multiple myeloma cancer cells.
16. An in vitro method of making an anti-BCMA CAR-T cell, comprising:
 - introducing into a T cell a nucleic acid encoding an anti-BCMA chimeric antigen receptor (CAR) comprising
 - an anti-BCMA single-chain variable fragment (scFv) comprising

a heavy chain variable region (V_H) having the amino acid sequence of SEQ ID NO: 3, and

a light chain variable region (V_L) having the amino acid sequence of SEQ ID NO: 5;

a transmembrane domain;

a co-stimulatory domain; and

an activating domain.

17. The method of Claim 16, wherein the nucleic acid is introduced into the T cell by a virus vector.

18. The method of Claim 17, wherein the virus vector is selected from the group consisting of a retrovirus vector, an adenovirus vector, an adeno-associated virus (AAV) vector, a simian virus vector, a vaccinia virus vector, a Sendai virus vector, an Epstein-Barr virus (EBV) vector, and a HSV vector.