

Claims:

1. An isolated antibody, or an antigen-binding fragment thereof, comprising a heavy chain and a light chain having:
 - 5 a. a heavy chain CDR1 having the amino acid sequence of SEQ ID NO: 012, a heavy chain CDR2 having the amino acid sequence of SEQ ID NO: 013, a heavy chain CDR3 having the amino acid sequence of SEQ ID NO: 014, a light chain CDR1 having the amino acid sequence of SEQ ID NO: 015, a light chain CDR2 having the amino acid sequence of SEQ ID NO: 016,
 - 10 and a light chain CDR3 having the amino acid sequence of SEQ ID NO: 017; or
 - b. a heavy chain CDR1 having the amino acid sequence of SEQ ID NO: 051, a heavy chain CDR2 having the amino acid sequence of SEQ ID NO: 052,
 - 15 a heavy chain CDR3 having the amino acid sequence of SEQ ID NO: 053, a light chain CDR1 having the amino acid sequence of SEQ ID NO: 024, a light chain CDR2 having the amino acid sequence of SEQ ID NO: 025, and a light chain CDR3 having the amino acid sequence of SEQ ID NO: 054.
- 20 2. The antibody or antigen-binding fragment of claim 1, wherein the heavy chain of the antibody comprises the amino acid sequence of SEQ ID NO: 120, and the light chain of the antibody comprises the amino acid sequence of SEQ ID NO: 165.
- 25 3. The antibody or antigen-binding fragment of claim 1, wherein the heavy chain of the antibody comprises the amino acid sequence of SEQ ID NO: 136 and light chain of the antibody comprises the amino acid sequence of SEQ ID NO: 168.
4. The antibody or antigen-binding fragment of any one of claims 1 to 3, wherein said
 - 30 antibody or antigen-binding fragment is IgG1 or IgG4 isotype.
5. An isolated CD123 (IL3-R α) x CD3 bispecific antibody or antigen-binding fragment comprising a first heavy chain (HC1), a second heavy chain (HC2), first light chain (LC1) and a second light chain (LC2), such that the HC1 and the LC1 pair to form
 - 35 a first antigen-binding site that immunospecifically binds CD123 (IL3-R α), and the

HC2 and the LC2 pair to form a second antigen-binding site that immunospecifically binds CD3, or a CD123 (IL3-R α) x CD3 -bispecific binding fragment thereof, wherein:

- 5 i) HC1 and LC1 comprise either of the following pairs:
 - a. SEQ ID NO: 203 and SEQ ID NO: 204, or
 - b. SEQ ID NO: 205 and SEQ ID NO: 206, respectively; and
 - 10 ii) HC2 and LC2 comprise either of the following pairs:
 - a. SEQ ID NO: 193 and SEQ ID NO: 194,
 - b. SEQ ID NO: 195 and SEQ ID NO: 196,
 - c. SEQ ID NO: 197 and SEQ ID NO: 198,
 - d. SEQ ID NO: 199 and SEQ ID NO: 200, or
 - e. SEQ ID NO: 201 and SEQ ID NO: 202, respectively.
 - 15 6. The bi-specific antibody or antigen-binding fragment of claim 5 wherein HC1 comprises SEQ ID NO: 203 and LC1 comprises SEQ ID NO: 204 and HC2 comprises SEQ ID NO: 193 and LC2 comprises SEQ ID NO: 194.
 - 20 7. The bi-specific antibody or antigen-binding fragment of claim 5 wherein HC1 comprises SEQ ID NO: 205 and LC1 comprises SEQ ID NO: 206 and HC2 comprises SEQ ID NO: 193 and LC2 comprises SEQ ID NO: 194.
 - 25 8. An isolated CD123 (IL3-R α) x CD3 bispecific antibody or a CD123 (IL3-R α) x CD3-bispecific binding fragment comprising:
 - a) a first heavy chain (HC1);
 - b) a second heavy chain (HC2);
 - c) a first light chain (LC1); and
 - d) a second light chain (LC2),
 wherein the HC1 and the LC1 pair to form a first antigen-binding site that
 - 30 immunospecifically binds CD123 (IL3-R α), and the HC2 and the LC2 pair to form a second antigen-binding site that immunospecifically binds CD3, wherein
 - 35 a. the paired heavy and light chain that immunospecifically binds CD3, wherein said heavy chain (HC2) comprises SEQ ID NO: 184 and said light chain (LC2) comprises SEQ ID NO: 190, and

- b. the paired heavy and light chain that immunospecifically binds CD123, wherein
 - i. said heavy chain (HC1) comprises SEQ ID NO: 120 and said light chain (LC1) comprises SEQ ID NO: 165, or
 - ii. said heavy chain (HC1) comprises SEQ ID NO: 136 and said light chain (LC1) comprises SEQ ID NO: 168.
- 9. An isolated cell expressing the antibody or antibody fragment of any one of claims 1 to 8.
- 10. An antibody or antigen-binding fragment thereof of any one of claims 1 to 8 for use in a method of treating cancer.
- 11. A CD123 (IL3-R α) x CD3 bispecific antibody or bispecific binding fragment of any one of claims 5 to 8 for use in a method for inhibiting growth or proliferation of cancer cells, wherein the method comprises:
 - administering a therapeutically effective amount of the CD123 (IL3-R α) x CD3 bispecific antibody or bispecific binding fragment to inhibit the growth or proliferation of cancer cells.
- 12. A CD123 (IL3-R α) x CD3 bispecific antibody or bispecific binding fragment of any one of claims 5 to 8 for use in a method for redirecting a T cell to a CD123-expressing cancer cell, wherein the method comprises:
 - administering a therapeutically effective amount of the CD123 (IL3-R α) x CD3 bispecific antibody or bispecific binding fragment to redirect a T cell to a cancer.
- 13. A pharmaceutical composition comprising the CD123 (IL3-R α) x CD3 bispecific antibody or bispecific binding fragment of any one of claims 5 to 8 and a pharmaceutically acceptable carrier.
- 14. An isolated synthetic polynucleotide encoding an antibody or antibody fragment of any one of claims 5 to 8.

15. A kit comprising the antibody or antigen-binding fragment thereof of any one of claims 1 to 8 and packaging for the same.
16. The bi-specific antibody or antigen-binding fragment of any one of claims 5 to 8,
5 wherein said bi-specific antibody or antigen-binding fragment binds immunospecifically to CD123 SP2 (IL-3Ra) and CD123 SP1 (IL3Ra).