

## CLAIMS

1. An antibody molecule or an antigen-binding fragment thereof, comprising or consisting of:

(i) a polypeptide chain of formula (I):

VH-CH1-Fc-X-VHH; and

(ii) a polypeptide chain of formula (II):

VL-CL;

wherein:

the VH represents a heavy chain variable region;

the CH represents a heavy chain constant region;

the Fc comprises CH2, CH3, and optionally CH4;

the CH1, the CH2, the CH3 and the CH4 represent domains 1, 2, 3 and 4, respectively, of the heavy chain constant region;

the X may be absent, or represents a linker when present;

the VHH represents a single-domain antigen-binding site;

the VL represents a light chain variable region;

the CL represents a light chain constant region;

optionally, a hinge region is present between the CH1 and the Fc.

2. The antibody molecule or the antigen-binding fragment thereof according to claim 1, comprising or consisting of 1 or 2 polypeptide chains of formula (I) and 1 or 2 polypeptide chains of formula (II).

3. The antibody molecule or the antigen-binding fragment thereof according to claim 1 or 2, wherein the linker is a flexible linker, and preferably the linker comprises an amino acid sequence (Gly<sub>4</sub>Ser)<sub>n</sub>, wherein n is a positive integer equal to or greater than 1, e.g., n is a positive integer from 1 to 7, such as 1, 2, 3, 4, 5 or 6.

4. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-3, wherein the antibody or the fragment thereof is a human antibody or a humanized antibody, or a chimeric antibody.

5. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-4, wherein the single-domain antigen-binding site (VHH) is a heavy chain variable domain of an antibody naturally devoid of light chains, e.g., a heavy chain variable domain of a heavy chain antibody naturally existing in a Camelidae species, or a VH-like single domain in an immunoglobulin of fish referred to as a new antigen receptor (e.g., IgNAR naturally existing in shark serum), or a recombinant single-domain antigen-binding site derived therefrom (e.g., a camelized human VH domain or a humanized Camelidae antibody heavy chain variable domain); preferably, the single-domain antigen-binding site is selected from a heavy chain variable domain of a heavy chain antibody naturally existing in a Camelidae species, a camelized human VH domain and a humanized Camelidae antibody heavy chain variable domain.

6. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-5, wherein the "CH1-Fc" of the formula (I) is in the form of IgG, e.g., IgG1, IgG2 or IgG4, and/or the CL of the formula (II) is from  $\kappa$  or  $\lambda$ .

7. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-6, wherein an antigen-binding site formed by the VH and VL is specific for a first antigen and an antigen-binding site formed by the VHH is specific for a second antigen; preferably, the first antigen is the same as or different from the second antigen.

8. The antibody molecule or the antigen-binding fragment thereof according to claim 7, wherein the first antigen and the second antigen are selected from a cytokine, a growth factor, a hormone, a signaling protein, an inflammatory mediator, a ligand, a cell surface receptor or a fragment thereof, a tumor-associated antigen, an immune checkpoint molecule, an angiogenic factor, a member of a tumor necrosis factor receptor superfamily, a co-stimulatory molecule in immune system, and ligands and/or receptors thereof, such as OX40, CD47, PD1, PD-L1, PD-L2, LAG-3, 4-1BB (CD137), VEGF and GITR.

9. The antibody molecule or the antigen-binding fragment thereof according to claim 7, wherein the first antigen is LAG-3, e.g., human LAG-3; and/or wherein the second antigen is PD-L1, e.g., human PD-L1.

10. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-9, wherein the VHH in the formula (I):

(i) comprises three complementarity determining regions (VHH CDRs) in SEQ ID NO: 6;  
or

(ii) comprises complementarity determining regions (CDRs) VHH CDR1, VHH CDR2 and

VHH CDR3, wherein the VHH CDR1 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 10, the VHH CDR2 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 11, and the VHH CDR3 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 12; or

(iii) comprises or consists of a sequence set forth in SEQ ID NO: 6; or

(iv) comprises or consists of an amino acid sequence having at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity to an amino acid sequence set forth in SEQ ID NO: 6.

11. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-10, wherein

the VH in the formula (I):

(i) comprises three complementarity determining regions HCDRs of a heavy chain variable region VH set forth in SEQ ID NO: 2; or

(ii) comprises complementarity determining regions (CDRs) HCDR1, HCDR2 and HCDR3, wherein the HCDR1 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 13, the HCDR2 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 14, and the HCDR3 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 15; or

(iii) comprises or consists of an amino acid sequence set forth in SEQ ID NO: 2; or

(iv) comprises or consists of an amino acid sequence having at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity to an amino acid sequence set forth in SEQ ID NO: 2;

and/or

the VL:

(i) comprises three complementarity determining regions LCDRs of a heavy chain variable region VL set forth in SEQ ID NO: 8; or

(ii) comprises complementarity determining regions (CDRs) LCDR1, LCDR2 and LCDR3, wherein the LCDR1 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 16, the LCDR2 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 17, and the LCDR3 comprises or consists of an amino acid sequence set forth in SEQ ID NO: 18; or

(iii) comprises or consists of an amino acid sequence set forth in SEQ ID NO: 8; or

(iv) comprises or consists of an amino acid sequence having at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity to an amino acid sequence set forth in SEQ ID NO: 8.

12. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-11, wherein

(a) the VH-CH1-Fc in the formula (I):

(i) comprises or consists of an amino acid sequence having at least 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity to an amino acid sequence set forth in SEQ ID NO: 19; or

(ii) comprises or consists of an amino acid sequence set forth in SEQ ID NO: 19;

and/or

(b) the VL-CL of the formula (II):

(i) comprises or consists of an amino acid sequence having at least 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity to an amino acid sequence set forth in SEQ ID NO: 7; or

(ii) comprises or consists of an amino acid sequence set forth in SEQ ID NO: 7.

13. The antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-12, wherein the polypeptide chain of formula (I) comprises or consists of a sequence set forth in SEQ ID NO: 1 or an amino acid sequence having at least 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity thereto; and/or wherein the polypeptide chain of formula (II) comprises or consists of a sequence set forth in SEQ ID NO: 7 or an amino acid sequence having at least 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% identity thereto.

14. An isolated nucleic acid encoding any one or more polypeptide chains of the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13.

15. A vector comprising the nucleic acid according to claim 14, wherein, preferably, the vector is an expression vector, such as a pTT5 vector.

16. A host cell, comprising the nucleic acid according to claim 14 or the vector according to claim 15, wherein, preferably, the host cell is prokaryotic or eukaryotic; more preferably, the host cell is selected from an *E. coli* cell, a yeast cell, a mammalian cell and other cells suitable for preparation of the antibody or the antigen-binding fragment thereof; most preferably, the host cell is a 293 cell or a CHO cell.

17. A method for preparing the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13, comprising culturing the host cell according to claim

16 under conditions suitable for expressing the nucleic acid according to claim 14, and optionally isolating the antibody or the antigen-binding fragment thereof, wherein optionally, the method further comprises isolating the antibody or the antigen-binding fragment thereof from the host cell.

18. An immunoconjugate, comprising the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13 and an additional substance, e.g., a therapeutic agent or a label, such as a cytotoxic agent.

19. A pharmaceutical composition, comprising the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13 or the immunoconjugate according to claim 18, and optionally a pharmaceutical supplementary material.

20. A pharmaceutical composition, comprising the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13 or the immunoconjugate according to claim 17 and an additional therapeutic agent, and optionally a pharmaceutical supplementary material, wherein, preferably, the additional therapeutic agent is selected from a chemotherapeutic agent, an additional antibody, a cytotoxic agent, a vaccine, an anti-infective active agent, a small molecule drug and an immunomodulatory agent.

21. A combination product, comprising the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13 or the immunoconjugate according to claim 18, and one or more additional therapeutic agents, such as a chemotherapeutic agent, a cytotoxic agent, a vaccine, an additional antibody, an anti-infective active agent, a small molecule drug, or an immunomodulatory agent.

22. A use of the antibody molecule or the antigen-binding fragment thereof according to any one of claims 1-13, the immunoconjugate according to claim 18, the pharmaceutical composition according to claim 19 or 20, or the combination product according to claim 21 in the preparation of a medicament for preventing or treating a disease in a subject, wherein the disease is, for example, an autoimmune disease, an inflammatory disease, an infection, or a tumor; for example, the tumor is a cancer, e.g., a cancer with elevated expression levels of PD-1, PD-L1 or PD-L2 and/or LAG-3, e.g., colon cancer or colorectal cancer or rectal cancer, and wherein an effective amount of the antibody molecule or the antigen-binding fragment thereof, the immunoconjugate, the pharmaceutical composition, or the combination product is to be administered to the subject.

23. The use according to claim 22, further comprising one or more additional therapies, wherein the therapy, for example, comprises a therapeutic modality and/or an additional therapeutic agent; preferably, the therapeutic modality comprises surgical treatment and/or radiotherapy, or the therapeutic agent is selected from a chemotherapeutic agent, a cytotoxic agent, a vaccine, an additional antibody, an anti-infective active agent, a small molecule drug and an immunomodulatory agent to be co-administered to the subject.

24. A method for detecting an antigen in a sample, comprising

(a) contacting the sample with the antibody or the antigen-binding fragment thereof according to any one of claims 1-13; and

(b) detecting a complex formed by the antibody or the antigen-binding fragment thereof and the antigen, wherein, optionally, the antibody is detectably labeled.