WHAT IS CLAIMED IS:

1. An antibody-like binding protein that specifically binds CA6, wherein the antibody-like binding protein comprises two polypeptides having structures represented by the formulas [I] and [II] below:

$$V_{L1}\text{-}L_1\text{-}V_{L2}\text{-}C_L \qquad [I]$$

$$V_{H1}\text{-}L_2\text{-}V_{H2}\text{-}C_{H1} \qquad [II]$$

wherein:

V_{LI} is a DS6-based immunoglobulin light chain variable domain;

V_{L2} is a DS6-based immunoglobulin light chain variable domain;

V_{HI} is a DS6-based immunoglobulin heavy chain variable domain;

V_{H2} is a DS6-based immunoglobulin heavy chain variable domain;

C_L is an immunoglobulin light chain constant domain, such as a human IGKC immunoglobulin light chain constant domain;

C_{H1} is an immunoglobulin C_{H1} heavy chain constant domain, such as a human immunoglobulin C_{H1} heavy chain constant domain;

L_1 and L_2 are amino acid linkers; and

wherein the polypeptides of formula I and the polypeptides of formula II form a bivalent monospecific tandem immunoglobulin antibody-like binding protein.

2. The antibody-like binding protein of claim 1, wherein L_1 is GGGGS or

GGGGSGGGGS (SEQ ID NO: 3).

3. The antibody- like binding protein of claim 1 or 2, wherein L_2 is GGGGS or GGGGSGGGGS (SEQ ID NO: 3).

4. The antibody-like binding protein of any one of claims 1 to 3, wherein L_1 and L_2 are identical.

5. The antibody- like binding protein of any one of claims 1 to 4, wherein V_{L1} and

V_{L2} domains are identical.

6. The antibody-like binding protein of any one of claims 1 to 5, wherein V_{H1} and V_{H2} are identical.

7. The antibody-like binding protein of any one of claims 1 to 6, wherein the polypeptide of formula [I] comprises SEQ ID NO: 1.

8. The antibody- like binding protein of any one of claims 1 to 7, wherein the polypeptide of formula [II] comprises SEQ ID NO: 7.

9. The antibody- like binding protein of any one of claims 1 to 8, further comprising a tag.

10. The antibody-like binding protein of claim 9, wherein the tag is 6x-Histidine, biotin, MYC, V5, FLAG, MBP, or glutathione-S-transferase, or HA.

11. The antibody- like binding protein of claim 10, wherein the tag is a 6x-Histidine tag.

12. The antibody- like binding protein of any one of claims 1 to 11, further comprising at least one radiolabel, imaging agent, therapeutic agent, or diagnostic agent.

13. The antibody- like binding protein of claim 12, wherein the radiolabel, imaging agent, therapeutic agent, or diagnostic agent is ^{110}In, ^{U1}ln, ^{177}Lu, ^{18}F, ^{52}Fe, ^{62}Cu, ^{64}Cu, ^{67}Cu, ^{67}Ga, ^{68}Ga, ^{86}Y, ^{90}Y, ^{89}Zr, ^{94}Tc, ^{94}Tc, ^{99m}Tc, ^{120}I, ^{123}I, ^{124}I, ^{125}I, ^{131}I, $^{154"158}$Gd, ^{32}P, ^{11}C, ^{13}N, ^{15}O, ^{186}Re, ^{188}Re, ^{51}Mn, ^{52m}Mn, ^{55}Co, ^{72}As, ^{75}Br, ^{76}Br, ^{82m}Rb, or ^{83}Sr.

14. The antibody-like binding protein of claim 11 or 12, wherein the radiolabel, imaging agent, therapeutic agent, or diagnostic agent comprises one or more agents for magnetic resonance imaging (MRI); positron emission tomography (PET); single photon emission tomography (SPECT); optical imaging, computed tomography (CT); ultrasound, X-ray, or photoacoustic imaging.

15. An isolated nucleic acid molecule encoding the polypeptide of either formula [I] or [II] of the antibody-like binding protein of any one of claims 1 to 11.

16. The isolated nucleic acid molecule of claim 15, wherein the nucleic acid molecule comprises the nucleotide sequence of SEQ ID NO: 5.

17. The isolated nucleic acid molecule of claim 15, wherein the nucleic acid molecule comprises the nucleotide sequence of SEQ ID NO: 10.

18. An expression vector comprising the nucleic acid molecule of any one of claims 15 to 17.

19. An isolated host cell comprising the nucleic acid molecule of claim 18.

20. An isolated host cell comprising the expression vector of claim 19.

21. The host cell of either claim 19 or 20, wherein the host cell is a mammalian cell or an insect cell.

22. A method for making an antibody-like binding protein that specifically binds CA6, comprising expressing in a cell one or more nucleic acid molecules encoding polypeptides having structures represented by the formulas [I] and [II] below:

$$V_{L1}\text{-}L_1\text{-}V_{L2}\text{-}C_L \qquad [I]$$

$$V_{H1}\text{-}L_2\text{-}V_{H2}\text{-}C_{H1} \qquad [II]$$

wherein:

V_{L1} is a DS6-based immunoglobulin light chain variable domain;

V_{L2} is a DS6-based immunoglobulin light chain variable domain;

V_{H1} is a DS6-based immunoglobulin heavy chain variable domain;

V_{H2} is a DS6-based immunoglobulin heavy chain variable domain;

C_L is an immunoglobulin light chain constant domain, such as a human IGKC immunoglobulin light chain constant domain;

C_{H1} is an immunoglobulin C_{HI} heavy chain constant domain, such as a human immunoglobulin C_{HI} heavy chain constant domain;

L_1 and L_2 are amino acid linkers; and

wherein the polypeptides of formula I and the polypeptides of formula II form a bivalent monospecific tandem immunoglobulin antibody-like binding protein.

23. The method of claim 22, wherein said antibody- like binding protein is an antibody- like binding protein as defined in any one of claims 1 to 14.

WHAT IS CLAIMED IS:

1. An antibody-like binding protein that specifically binds the tumor-associated MUC1 sialoglycotype CA6, characterized in that the antibody-like binding protein comprises two polypeptides having structures represented by the formulas [I] and [II] below:

$$V_{L1}\text{-}L_1\text{-}V_{L2}\text{-}C_L \qquad [I]$$

$$V_{H1}\text{-}L_2\text{-}V_{H2}\text{-}C_{H1} \qquad [II]$$

wherein:

V_{L1} is an immunoglobulin light chain variable domain derived from the DS6 antibody;

V_{L2} is an immunoglobulin light chain variable domain derived from the DS6 antibody;

V_{HI} is an immunoglobulin heavy chain variable domain derived from the DS6 antibody;

V_{H2} is an immunoglobulin heavy chain variable domain derived from the DS6 antibody;

C_L is an immunoglobulin light chain constant domain, such as a human IGKC immunoglobulin light chain constant domain;

C_{H1} is an immunoglobulin C_{H1} heavy chain constant domain, such as a human immunoglobulin C_{H1} heavy chain constant domain;

L_1 and L_2 are amino acid linkers; and

wherein the polypeptides of formula I and the polypeptides of formula II form a bivalent monospecific tandem immunoglobulin antibody-like binding protein, wherein the polypeptide of formula [I] comprises a sequence at least 80% identical to SEQ ID NO: 1 and the polypeptide of formula [II] comprises a sequence at least 80% identical to SEQ ID NO: 7.

2. The antibody-like binding protein according to claim 1, wherein V_{L1} and V_{L2} are defined by sequence SEQ ID NO: 2; and V_{H1} and V_{H2} are defined by sequence SEQ ID NO: 8.

3. The antibody-like binding protein according to claim 1 or claim 2, wherein L_1 is GGGGS or GGGGSGGGGS (SEQ ID NO: 3).

4. The antibody- like binding protein according to anyone of claims 1 to 3, wherein L_2 is GGGGS or GGGGSGGGGS (SEQ ID NO: 3).

5. The antibody-like binding protein according to any one of claims 1 to 4, wherein the polypeptide of formula [I] comprises SEQ ID NO: 1.

6. The antibody- like binding protein according to any one of claims 1 to 5, wherein the polypeptide of formula [II] comprises SEQ ID NO: 7.

7. The antibody- like binding protein according to any one of claims 1 to 6, further comprising at least one radiolabel, imaging agent, therapeutic agent, or diagnostic agent.

8. The antibody- like binding protein according to claim 7, wherein the radiolabel, imaging agent, therapeutic agent, or diagnostic agent is ^{110}In, ^{U1}ln, ^{177}Lu, ^{18}F, ^{52}Fe, ^{62}Cu, ^{64}Cu, ^{67}Cu, ^{67}Ga, ^{68}Ga, ^{86}Y, ^{90}Y, ^{89}Zr, ^{94}Tc, ^{94}Tc, ^{99m}Tc, ^{120}I, ^{123}I, ^{124}I, ^{125}I, ^{131}I, $^{154"158}$Gd, ^{32}P, ^{11}C, ^{13}N, ^{15}O, ^{186}Re, ^{188}Re, ^{51}Mn, ^{52m}Mn, ^{55}Co, ^{72}As, ^{75}Br, ^{76}Br, ^{82m}Rb, or ^{83}Sr.

9. The antibody-like binding protein according to claims 7 or 8, wherein the radiolabel, imaging agent, therapeutic agent, or diagnostic agent comprises one or more agents for magnetic resonance imaging (MRI); positron emission tomography (PET); single photon emission tomography (SPECT); optical imaging, computed tomography (CT); ultrasound, X-ray, or photoacoustic imaging.

10. An isolated nucleic acid molecule encoding the polypeptide of either formula [I] or [II] of the antibody-like binding protein of any one of claims 1 to6.

11. The isolated nucleic acid molecule of claim 10, wherein the nucleic acid molecule comprises the nucleotide sequence of SEQ ID NO: 5 orSEQ ID NO: 10.

12. An expression vector comprising the nucleic acid molecule according to claim 10 or 11.

13. An isolated host cell comprising the nucleic acid molecule according to any one of claims 10 or 11.

14. An isolated host cell comprising the expression vector of claim 12.

15. A method for making an antibody-like binding protein that specifically binds the tumor-associated MUC1 sialoglycotype CA6, comprising expressing in a cell one or more nucleic acid molecules encoding polypeptides having structures represented by the formulas [I] and [II] below:

$$V_{L1}\text{-}L_1\text{-}V_{L2}\text{-}C_L \qquad [I]$$

$$V_{H1}\text{-}L_2\text{-}V_{H2}\text{-}C_{H1} \qquad [II]$$

wherein:

V_{L1} is an immunoglobulin light chain variable domain derived from the DS6 antibody;

V_{L2} is an immunoglobulin light chain variable domain derived from the DS6 antibody;

V_{H1} is an immunoglobulin heavy chain variable domain derived from the DS6 antibody;

V_{H2} is an immunoglobulin heavy chain variable domain derived from the DS6 antibody;

C_L is an immunoglobulin light chain constant domain, such as a human IGKC immunoglobulin light chain constant domain;

C_{H1} is an immunoglobulin C_{HI} heavy chain constant domain, such as a human immunoglobulin C_{HI} heavy chain constant domain;

L_1 and L_2 are amino acid linkers; and

wherein the polypeptides of formula I and the polypeptides of formula II form a bivalent monospecific tandem immunoglobulin antibody-like binding protein; and

wherein the polypeptide of formula [I] comprises a sequence at least 80% identical to SEQ ID NO: 1 and the polypeptide of formula [II] comprises a sequence at least 80% identical to SEQ ID NO: 7

16. The method according to claim 14, wherein V_{L1} and V_{L2} are defined by sequence SEQ ID NO: 2; and V_{H1} and V_{H2} are defined by sequence SEQ ID NO: 8.