

Title: Therapeutic binding compounds

The invention relates to the fields of biology, immunology and medicine.

Melanoma is caused by malignant melanocytes. It is primarily caused by
5 ultraviolet light exposure. Out of all different types of skin cancer malignant melanoma
has the highest rate of mortality. It is estimated that world wide around 55,000 people
have died from metastatic melanoma in 2012, a number which is steadily increasing
every year. If spread has not yet occurred, most patients are cured by removing the
melanoma. Patients with spread melanoma are treated with chemotherapy, radiation
10 therapy and/or recently developed immunotherapies such as adoptive T-cell therapy or
so called checkpoint inhibitor antibodies. These new immunotherapies clearly show that
the immune system is able to recognize and attack the melanoma tumor cells. However,
the response rate to such therapies is less than 50% and 5-years survival rates are
around 30%. Therefore, additional treatment options are highly needed. The present
15 invention provides means and methods for counteracting, preventing and/or detecting
melanoma and other diseases.

SUMMARY

In one aspect, the present disclosure refers to an isolated, synthetic or
20 recombinant antibody, or functional part thereof, that is specific for an epitope of CD9
comprising at least one amino acid selected from the group consisting of K169, D171,
V172 and L173 of the CD9 sequence as depicted in Figure 2.

In another aspect, the present disclosure refers to an isolated, synthetic or
recombinant antibody or functional part thereof that competes with an antibody as
25 disclosed herein for binding to amino acids K169, D171, V172, L173 and F176 of the CD9
sequence as depicted in Figure 2.

In yet another aspect, the present disclosure refers to an isolated, recombinant or
purified CD9 peptide with a length of at most 35 amino acid residues, wherein said
peptide comprises amino acids corresponding to K169, D171, V172, L173 and F176 of the
30 CD9 sequence as depicted in Figure 2.

In yet another aspect, the present disclosure refers to an isolated, synthetic or
recombinant nucleic acid molecule with a length of at least 15 nucleotides, encoding at
least one CDR sequence of an antibody or functional part disclosed herein.

In yet another aspect, the present disclosure refers to a nucleic acid molecule encoding an antibody or functional part disclosed herein.

In yet another aspect, the present disclosure refers to a vector comprising a nucleic acid molecule disclosed herein.

5 In yet another aspect, the present disclosure refers to an isolated or recombinant cell, or a non-human animal, comprising a nucleic acid molecule disclosed herein or a vector disclosed herein.

10 In yet another aspect, the present disclosure refers to a composition comprising an antibody or functional part disclosed herein, or a nucleic acid molecule disclosed herein, or a vector disclosed herein, or a cell disclosed herein.

15 In yet another aspect, the present disclosure refers to a kit of parts comprising an antibody or functional part disclosed herein, a nucleic acid molecule disclosed herein, a vector disclosed herein or a cell disclosed herein and a therapeutic agent useful in the treatment and/or prevention of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

In yet another aspect, the present disclosure refers to an antibody or functional part disclosed herein, or a nucleic acid molecule disclosed herein, or a vector disclosed herein, or a cell disclosed herein, for use as a medicament or prophylactic agent.

20 In yet another aspect, the present disclosure refers to an antibody or functional part disclosed herein, or a nucleic acid molecule disclosed herein, or a vector disclosed herein, or a cell disclosed herein, for use in a method for at least in part treating or preventing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

25 In yet another aspect, the present disclosure refers to an antibody or functional part disclosed herein for *in vivo* use in diagnosis of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

30 In another aspect, the present disclosure refers to *in vitro* use of an antibody or functional part as disclosed herein for diagnosing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

35 In yet another aspect, the present disclosure refers to use of an antibody or functional part disclosed herein for determining whether a sample comprises CD9-expressing cells.

In yet another aspect, the present disclosure refers to a method for determining whether CD9-expressing cells are present in a sample comprising:
- contacting said sample with an antibody or functional part

disclosed herein, and

- allowing said antibody or functional part to bind CD9-expressing cells, if present, and
- determining whether or not CD9-expressing cells are bound to said antibody or functional part, thereby determining whether or not CD9-expressing cells are present in said sample.

In yet another aspect, the present disclosure refers to a method for producing an antibody or functional part disclosed herein, the method comprising providing a cell with a nucleic acid molecule or a vector disclosed herein, and allowing said cell to translate said nucleic acid molecule or vector, thereby producing said antibody or functional part disclosed herein, the method preferably further comprising harvesting, purifying and/or isolating said antibody or functional part disclosed herein.

In yet another aspect, the present disclosure refers to use of a therapeutically effective amount of an antibody or functional part disclosed herein, or a nucleic acid molecule disclosed herein, or a vector disclosed herein, or a cell disclosed herein, or a composition disclosed herein in the manufacture of a medicament for at least in part treating and/or preventing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

In yet another aspect, the present disclosure refers to an *ex vivo* method for determining whether an individual is suffering from a CD9-positive cancer, the method comprising:

- contacting tumor cells from said individual with an antibody or functional part disclosed herein,
- allowing said antibody or functional part to bind CD9-expressing cells, if present, and
- determining whether or not CD9-expressing cells are bound to said antibody or functional part, thereby determining whether or not said individual is suffering from a CD9-positive cancer.

In yet another aspect, the present disclosure refers to an antibody disclosed herein, or an antibody for use disclosed herein, or a use disclosed herein, or a method disclosed herein, wherein said antibody is antibody AT14-012 or a functional part thereof.

In yet another aspect, the present disclosure refers to an isolated, synthetic or recombinant nucleic acid molecule, encoding a CD9 peptide disclosed herein.

In yet another aspect, the present disclosure refers to a vector comprising a nucleic acid molecule disclosed herein.

5 In yet another aspect, the present disclosure refers to a host cell comprising a nucleic acid molecule disclosed herein, and/or a vector disclosed herein.

In yet another aspect, the present disclosure refers to use of a CD9 peptide disclosed herein, or a nucleic acid molecule disclosed herein, or a vector disclosed herein, for producing, binding, detecting and/or obtaining an immune cell and/or an antibody, or
10 a functional part thereof, that is specific for CD9.

In yet another aspect, the present disclosure refers to a method for producing a CD9-specific immune cell or a CD9-specific antibody, wherein a non-human animal is to be immunized with a CD9 peptide disclosed herein or with a nucleic acid molecule disclosed herein or with a vector disclosed herein.

15 In yet another aspect, the present disclosure refers to an antibody or immune cell obtainable by a method disclosed herein.

In yet another aspect, the present disclosure refers to an immunogenic composition comprising a CD9 peptide disclosed herein, or a nucleic acid molecule disclosed herein or a vector disclosed herein.

20 In yet another aspect, the present disclosure refers to a diagnostic kit comprising a CD9 peptide disclosed herein and means for detecting antibody-bound or immune cell-bound CD9 peptides.

In yet another aspect, the present disclosure refers to a CD9 peptide disclosed herein or a nucleic acid molecule disclosed herein or a vector disclosed herein for use as a
25 medicament or prophylactic agent.

In yet another aspect, the present disclosure refers to a CD9 peptide disclosed herein or a nucleic acid molecule disclosed herein or a vector disclosed herein for use in immunotherapy.

30 In yet another aspect, the present disclosure refers to *in vitro* use of a CD9 peptide disclosed herein for use as a diagnostic agent for diagnosing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

In another aspect, the present disclosure refers to a synthetic or recombinant
35 antibody, or a functional part thereof, which comprises a Fab fragment of an antibody as disclosed herein and a Fab fragment of a CD55 blocking antibody, a CD46 blocking antibody, a CD59 blocking antibody, an anti-CTLA4 antibody, an anti-PD-1 antibody, an anti-PD-L1 antibody, an anti-PD-L2 antibody, an anti-SIRPα antibody, an anti-TIM3 antibody, an anti-LAG3 antibody, an anti-CD276 antibody, an anti-CD272 antibody, an
40 anti-KIR antibody, an anti-A2AR antibody, an anti-VISTA antibody or an anti-IDO antibody, preferably an anti-PD-1 antibody or an anti-PD-L1 antibody.

Claims

1. An isolated, synthetic or recombinant antibody, or functional part thereof, that is specific for an epitope of CD9 comprising at least one amino acid selected from the group consisting of K169, D171, V172 and L173 of the CD9 sequence as depicted in Figure 2.
2. An isolated, synthetic or recombinant antibody or functional part according to claim 1, that is specific for an epitope of CD9 comprising amino acids corresponding to K169, D171, V172, L173 and F176 of the CD9 sequence as depicted in Figure 2.
3. An isolated, synthetic or recombinant antibody or a functional part according to claim 1 or 2, that comprises:
 - a heavy chain CDR1 sequence comprising the sequence DYAMH, or a sequence having at most 2 amino acid deviations thereof; and
 - a heavy chain CDR2 sequence comprising the sequence GISWNSGSIVYADSVKG, or a sequence having at most 2 amino acid deviations thereof; and
 - a heavy chain CDR3 sequence comprising the sequence AVSGYYPYFDY, or a sequence having at most 2 amino acid deviations thereof; and
 - a light chain CDR1 sequence comprising the sequence KSSQSVLYSSNNKNYLG, or a sequence having at most 2 amino acid deviations thereof; and
 - a light chain CDR2 sequence comprising the sequence WASTRES, or a sequence having at most 2 amino acid deviations thereof; and
 - a light chain CDR3 sequence comprising the sequence QQYYTTP, or a sequence having at most 2 amino acid deviations thereof.
4. An antibody or functional part according to any one of claims 1-3, that comprises:
 - a heavy chain CDR1 sequence DYAMH or DYAMY; and
 - a heavy chain CDR2 sequence GISWNSGSIVYADSVKG; and
 - a heavy chain CDR3 sequence AVSGYYPYFDY or AVSGYFPYFDY or AVSGYYPYFHY or AVSGYFPYFHY; and
 - a light chain CDR1 sequence KSSQSVLYSSNNKNYLG; and
 - a light chain CDR2 sequence WASTRES or WASIRES; and
 - a light chain CDR3 sequence QQYYTTP.
5. An antibody or functional part according to any one of claims 1-4, comprising a heavy chain variable region sequence having at least 80% sequence identity with the sequence
EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMHWVRQAPGKGLEWVSGISW

NSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYYPYFD
YWGQGILVTVSS.

6. An antibody or functional part according to any one of claims 1-5, comprising a light chain variable region sequence having at least 80% sequence identity with the sequence

DIVMTQSPDLSVSLGERATINCKSSQSVLYSSNNKNYLGWYQQKPGQPPKLLIY
WASTRESGVPDRFSGSGGTDFLTISLQAEDVAVYYCQQYYTTPSTFGQGTRL
EIK.

7. An antibody or functional part according to any one of claims 1-6 comprising:

- a heavy chain variable region sequence

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMHWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYYP
YFDYWGQGILVTVSS, or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMYWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFDYWGQGILVTVSS or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMHWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFDYWGQGILVTVSS or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMHWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFHYWGQGILVTVSS or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMYWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFDYWGQGILVTVSS or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMYWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFDYWGQGILVTVSS or

EVQVVESGGGLVQPGRSLRLSCAASGFTFDDYAMYWVRQAPGKGLEWVSGIS
WNSGSIVYADSVKGRFTISRDNANKNSLYLQLNSLRAEDTAFYYCAKAVSGYFP
YFHYWGQGILVTVSS and/or

- a light chain variable region sequence

DIVMTQSPDLSVSLGERATINCKSSQSVLYSSNNKNYLGWYQQKPGQPPKLL
IYWASTRESGVPDRFSGSGGTDFLTISLQAEDVAVYYCQQYYTTPSTFGQG
TRLEIK or

DIVMTQSPDLSVSLGERATINCKSSQSVLYSSNNKNYLGWYQQKPGQPPKLL
 IYWASIRESGVPDRFSGSGSGTDFTLTISSLQAEDVAVYYCQQYYTTPSTFGQG
 TRLEIK.

- 5 8. An antibody or functional part according to any one of claims 1-7, that is a human antibody or functional part thereof.
9. An antibody or functional part according to any one of claims 1-8, that is able to bind melanoma cells, colon carcinoma cells, pancreas carcinoma cells and esophagus carcinoma cells.
- 10 10. An antibody or functional part according to any one of claims 1-9, wherein said antibody is of the IgG isotype, preferably IgG1 or IgG3.
11. An antibody or functional part according to claim 10 comprising an arginine at amino acid position 345.
12. An isolated, synthetic or recombinant antibody or functional part thereof that competes with an antibody according to claim 3 or 4 for binding to amino acids K169,
15 D171, V172, L173 and F176 of the CD9 sequence as depicted in Figure 2.
13. An antibody or functional part according to any one of claims 1-12, that is coupled to another compound.
14. An antibody or functional part according to claim 13, wherein said other compound is a detectable label, a chemotherapeutic drug, a toxic moiety, an
20 immunomodulatory molecule, another CD9-specific binding compound, or a radioactive compound.
15. An isolated, recombinant or purified CD9 peptide with a length of at most 35 amino acid residues, wherein said peptide comprises amino acids corresponding to K169, D171, V172, L173 and F176 of the CD9 sequence as depicted in Figure 2.
- 25 16. An isolated, recombinant or purified CD9 peptide according to claim 15, that further comprises an amino acid corresponding to F176 of the CD9 sequence as depicted in Figure 2.
17. An isolated, synthetic or recombinant nucleic acid molecule with a length of at least 15 nucleotides, encoding at least one CDR sequence of an antibody or functional part
30 according to any one of claims 1-14.
18. A nucleic acid molecule according to claim 17, that encodes at least the heavy chain CDR 1-3 and the light chain CDR 1-3 sequences of an antibody or functional part according to any one of claims 1-14.

19. A nucleic acid molecule according to claim 17 or 18, that encodes at least the heavy chain variable region sequence and/or the light chain variable region sequence of an antibody or functional part according to any one of claims 1-14.
20. A nucleic acid molecule according to any one of claims 17-19, comprising a sequence
5 that has at least 80% sequence identity with a sequence selected from the group consisting of:
 - gat tat gcc atg cac; and
 - ggt att agt tgg aat agt ggt agc ata gtc tat gcg gac tct gtg aag ggc; and
 - gcc gtg agt ggt tat tat ccc tac ttt gac tac; and
 - 10 - aag tcc agc cag agt gtt tta tac agc tcc aac aat aag aac tac tta ggt; and
 - tgg gca tct acc cgg gaa tcc; and
 - . cag caa tat tat act act cct.
21. A nucleic acid molecule according to any one of claims 17-20, comprising a sequence that has at least 80% sequence identity with the sequence gaa gtg cag gtg gtg gag tct
15 ggg gga ggc ttg gta cag cct ggc agg tcc ctg aga ctc tcc tgt gca gcc tct gga ttc acc ttt gat gat tat gcc atg cac tgg gtc cgg caa gct cca ggg aag ggc ctg gag tgg gtc tca ggt att agt tgg aat agt ggt agc ata gtc tat gcg gac tct gtg aag ggc cga ttc acc atc tcc aga gac aac gcc aag aac tcc ctg tat ctg caa ctg aac agt ctg aga gct gag gac acg gcc ttc tat tac tgt gca aaa gcc gtg agt ggt tat tat ccc tac ttt gac tac tgg ggc cag gga att ttg gtc acc gtc tcc
20 tca, and/or comprising a sequence that has at least 80% sequence identity with the sequence gac atc gtg atg acc cag tct cca gac tcc ctg tct gtg tct ctg ggc gag agg gcc acc atc aac tgc aag tcc agc cag agt gtt tta tac agc tcc aac aat aag aac tac tta ggt tgg tac cag cag aaa cca gga cag cct cct aag ctg ctc att tac tgg gca tct acc cgg gaa tcc ggg gtc cct gac cga ttc agt ggc agc ggg tct ggg aca gat ttc act ctc acc atc agc agc ctg cag gct
25 gaa gat gtg gca gtt tat tac tgt cag caa tat tat act act cct tcc acc ttc ggc caa ggg aca cga ctg gag att aaa.
22. A nucleic acid molecule encoding an antibody or functional part according to any one of claims 1-14.
23. A nucleic acid molecule according to any one of claims 17-22, that comprises cDNA,
30 peptide nucleic acid (PNA), locked nucleic acid (LNA), or a DNA/RNA helix.
24. A nucleic acid molecule according to any one of claims 17-23, that is codon optimized for expression in a non-human host cell.
25. A vector comprising a nucleic acid molecule according to any one of claims 17-24.
26. An isolated or recombinant cell, or a non-human animal, comprising a nucleic acid
35 molecule according to any one of claims 17-24 or a vector according to claim 25.

27. A composition comprising an antibody or functional part according to any one of claims 1-14, or a nucleic acid molecule according to any one of claims 17-24, or a vector according to claim 25, or a cell according to claim 26.
28. A composition according to claim 27, wherein said composition is a pharmaceutical composition that also comprises a pharmaceutically acceptable carrier, diluent or excipient.
29. A kit of parts comprising an antibody or functional part according to any one of claims 1-14, a nucleic acid molecule according to any one of claims 17-24, a vector according to claim 25 or a cell according to claim 26 and a therapeutic agent useful in the treatment and/or prevention of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.
30. The kit of parts according to claim 29, wherein said agent is a complement regulatory protein or an agent capable of stimulating C3 convertase formation or capable of counteracting inhibition of C3 convertase formation.
31. The kit of parts according to claim 30, wherein said agent is a CD55 blocking antibody or a CD46 blocking antibody or a CD59 blocking antibody or an antibody against another complement regulatory protein, preferably a CD55 blocking antibody.
32. The kit of parts according to claim 29, wherein said agent is a blocking antibody specific for a co-inhibitory T cell molecule, or a small molecule against mutated BRAF, or another chemotherapy agent.
33. The kit of parts according to claim 32, wherein said antibody is selected from the group consisting of an anti-CTLA4 antibody, an anti-PD-1 antibody, an anti-PD-L1 antibody, an anti-PD-L2 antibody, an anti-SIRP α antibody, an anti-TIM3 antibody, an anti-LAG3 antibody, an anti-CD276 antibody, an anti-CD272 antibody, an anti-KIR antibody, an anti-A2AR antibody, an anti-VISTA antibody and an anti-IDO antibody, and preferably is a PD1 blocking antibody or a PDL1 blocking antibody.
34. An antibody or functional part according to any one of claims 1-14, or a nucleic acid molecule according to claim 22, or a vector according to claim 25, or a cell according to claim 26, for use as a medicament or prophylactic agent.
35. An antibody or functional part according to any one of claims 1-14, or a nucleic acid molecule according to claim 22, or a vector according to claim 25, or a cell according to claim 26, for use in a method for at least in part treating or preventing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus

infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

36. An antibody or functional part according to any one of claims 1-14 for *in vivo* use in diagnosis of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

37. *In vitro* use of an antibody or functional part according to any one of claims 1-14 for diagnosing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

38. An antibody or functional part or nucleic acid molecule or vector or cell for use according to claim 35 or 36, or use according to claim 37, wherein said CD9 positive cancer is selected from the group consisting of melanoma, colorectal cancer, pancreatic cancer, esophageal cancer, lung cancer, breast cancer, ovarian cancer, stomach cancer, squamous cell carcinoma, AML, multiple myeloma, gastric cancer, liver cancer, brain cancer, Kaposi sarcoma, carcinoma mucoepidermoid, choriocarcinoma, fibrosarcoma, cervical carcinoma, glioma, adenocarcinoma, lung adenocarcinoma, non-small-cell lung carcinoma, bladder cancer and small cell lung cancer.

39. An antibody or functional part or nucleic acid molecule or vector or cell for use according to any one of claims 34-35 whereby said antibody or functional part or nucleic acid molecule or vector or cell is to be combined with a therapeutic agent useful in the treatment and/or prevention of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

40. An antibody or functional part or nucleic acid molecule or vector or cell for use according to claim 39 wherein said agent is a complement regulatory protein or an agent capable of stimulating C3 convertase formation or capable of counteracting inhibition of C3 convertase formation.

41. An antibody or functional part or nucleic acid molecule or vector or cell for use according to claim 40 wherein said agent is a CD55 blocking antibody or a CD46 blocking antibody or a CD59 blocking antibody or an antibody against another complement regulatory protein, preferably a CD55 blocking antibody.

42. An antibody or functional part or nucleic acid molecule or vector or cell for use according to claim 39 wherein said agent is a blocking antibody specific for a co-

inhibitory T cell molecule, or a small molecule against mutated BRAF, or another chemotherapy agent.

43. An antibody or functional part or nucleic acid molecule or vector or cell for use according to claim 42 wherein said antibody is selected from the group consisting of an anti-CTLA4 antibody, an anti-PD-1 antibody, an anti-PD-L1 antibody, an anti-PD-L2 antibody, an anti-SIRP α antibody, an anti-TIM3 antibody, an anti-LAG3 antibody, an anti-CD276 antibody, an anti-CD272 antibody, an anti-KIR antibody, an anti-A2AR antibody, an anti-VISTA antibody and an anti-IDO antibody, and preferably is a PD1 blocking antibody or a PDL1 blocking antibody.

44. Use of an antibody or functional part according to any one of claims 1-14 for determining whether a sample comprises CD9-expressing cells.

45. Use according to claim 44, for determining whether a sample comprises CD9-expressing tumor cells.

46. A method for determining whether CD9-expressing cells are present in a sample comprising:

- contacting said sample with an antibody or functional part according to any one of claims 1-14, and

- allowing said antibody or functional part to bind CD9-expressing cells, if present, and

- determining whether or not CD9-expressing cells are bound to said antibody or functional part, thereby determining whether or not CD9-expressing cells are present in said sample.

47. A method according to claim 46, wherein said CD9 expressing cells are CD9 positive tumor cells.

48. A method for producing an antibody or functional part according to any one of claims 1-14, the method comprising providing a cell with a nucleic acid molecule or a vector according to claim 22 or 25, and allowing said cell to translate said nucleic acid molecule or vector, thereby producing said antibody or functional part according to any one of claims 1-14, the method preferably further comprising harvesting, purifying and/or isolating said antibody or functional part according to any one of claims 1-14.

49. Use of a therapeutically effective amount of an antibody or functional part according to any one of claims 1-14, or a nucleic acid molecule according to claim 22, or a vector according to claim 25, or a cell according to claim 26, or a composition according to claim 27 or 28 in the manufacture of a medicament for at least in part

treating and/or preventing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

50. A use according to claim 49, wherein said CD9 positive cancer is selected from the group consisting of melanoma, colorectal cancer, pancreatic cancer, esophageal cancer, lung cancer, breast cancer, ovarian cancer, stomach cancer, squamous cell carcinoma, AML, multiple myeloma, gastric cancer, liver cancer, brain cancer, Kaposi sarcoma, carcinoma mucoepidermoid, choriocarcinoma, fibrosarcoma, cervical carcinoma, glioma, adenocarcinoma, lung adenocarcinoma, non-small-cell lung carcinoma, bladder cancer and small cell lung cancer.

51. A use according to claim 49 or 50, whereby said antibody or functional part or nucleic acid molecule or vector or cell is to be combined with a therapeutic agent useful in the treatment and/or prevention of a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

52. A use according to claim 51 wherein said agent is a complement regulatory protein or an agent capable of stimulating C3 convertase formation or capable of counteracting inhibition of C3 convertase formation.

53. A use according to claim 52 wherein said agent is a CD55 blocking antibody or a CD46 blocking antibody or a CD59 blocking antibody or an antibody against another complement regulatory protein, preferably a CD55 blocking antibody.

54. A use according to claim 51 wherein said agent is a blocking antibody specific for a co-inhibitory T cell molecule, or a small molecule against mutated BRAF, or another chemotherapy agent.

55. A use according to claim 54 wherein said antibody is selected from the group consisting of an anti-CTLA4 antibody, an anti-PD-1 antibody, an anti-PD-L1 antibody, an anti-PD-L2 antibody, an anti-SIRP α antibody, an anti-TIM3 antibody, an anti-LAG3 antibody, an anti-CD276 antibody, an anti-CD272 antibody, an anti-KIR antibody, an anti-A2AR antibody, an anti-VISTA antibody and an anti-IDO antibody, and preferably is a PD1 blocking antibody or a PDL1 blocking antibody.

56. An *ex vivo* method for determining whether an individual is suffering from a CD9-positive cancer, the method comprising:

- contacting tumor cells from said individual with an antibody or functional part according to any one of claims 1-14,

- allowing said antibody or functional part to bind CD9-expressing cells, if present,

and

- determining whether or not CD9-expressing cells are bound to said antibody or functional part, thereby determining whether or not said individual is suffering from a CD9-positive cancer.

- 5 57. An antibody according to any one of claims 1-14, or an antibody for use according to any one of claims 34-36 and 38-43, or a use according to any one claims 44-45 and 49-55, or a method according to any one of claims 46-48 and 56, wherein said antibody is antibody AT14-012 or a functional part thereof.
- 10 58. An isolated, synthetic or recombinant nucleic acid molecule, encoding a CD9 peptide according to any one of claims 15-16.
59. A vector comprising a nucleic acid molecule according to claim 58.
60. A host cell comprising a nucleic acid molecule according to claim 58, and/or a vector according to claim 59.
- 15 61. Use of a CD9 peptide according to any one of claims 15-16, or a nucleic acid molecule according to claim 58, or a vector according to claim 59, for producing, binding, detecting and/or obtaining an immune cell and/or an antibody, or a functional part thereof, that is specific for CD9.
- 20 62. A method for producing a CD9-specific immune cell or a CD9-specific antibody, wherein a non-human animal is to be immunized with a CD9 peptide according to any one of claims 15-16 or with a nucleic acid molecule according to claim 58 or with a vector according to claim 59.
63. A method according to claim 62, wherein a CD9-specific immune cell or antibody is to be further harvested from said non-human animal.
- 25 64. An antibody or immune cell obtainable by a method according to claim 62 or 63.
65. An immunogenic composition comprising a CD9 peptide according to any one of claims 15-16, or a nucleic acid molecule according to claim 58 or a vector according to claim 59.
66. A diagnostic kit comprising a CD9 peptide according to any one of claims 15-16 and means for detecting antibody-bound or immune cell-bound CD9 peptides.
- 30 67. A CD9 peptide according to any one of claims 15-16 or a nucleic acid molecule according to claim 58 or a vector according to claim 59 for use as a medicament or prophylactic agent.
68. A CD9 peptide according to any one of claims 15-16 or a nucleic acid molecule according to claim 58 or a vector according to claim 59 for use in immunotherapy.

69. *In vitro* use of a CD9 peptide according to any one of claims 15-16 for diagnosing a CD9 positive cancer, osteoporosis, arthritis, lung inflammation, COPD, colitis, a virus infection, a bacterial infection, CMV retinitis, oral candidiasis, Glanzmann thrombasthenia, or diphtheria.

5 70. A synthetic or recombinant antibody, or a functional part thereof, which comprises a Fab fragment of an antibody according to any one of claims 1-14 and a Fab
fragment of a CD55 blocking antibody, a CD46 blocking antibody, a CD59 blocking
antibody, an anti-CTLA4 antibody, an anti-PD-1 antibody, an anti-PD-L1 antibody, an
anti-PD-L2 antibody, an anti-SIRP α antibody, an anti-TIM3 antibody, an anti-LAG3
10 antibody, an anti-CD276 antibody, an anti-CD272 antibody, an anti-KIR antibody, an
anti-A2AR antibody, an anti-VISTA antibody or an anti-IDO antibody, preferably an
anti-PD-1 antibody or an anti-PD-L1 antibody.