Claims

1. A vector comprising:

a) a first nucleic acid sequence encoding a first polypeptide, wherein the first polypeptide comprises a targeting unit that targets antigen-presenting cells, a multimerization unit, such as a dimerization unit, and an antigenic unit comprising one or more antigens or parts thereof, such as one or more disease-relevant antigens or parts thereof; and

b) one or more further nucleic acid sequences encoding one or more immunostimulatory compounds,

wherein the vector allows for the co-expression of the first polypeptide and the one or more immunostimulatory compounds as separate molecules.

2. The vector according to claim 1, wherein the one or more immunostimulatory compounds promote attraction and/or activation and/or maturation and/or proliferation, such as growth and/or expansion, of antigen-presenting cells, preferably of human antigen-presenting cells.

3. The vector according to any of claims 1 to 2, wherein the one or more immunostimulatory compounds promote attraction of antigen-presenting cells, preferably wherein the one or more immunostimulatory compounds are chemokines, preferably human chemokines, more preferably, wherein the one or more immunostimulatory compounds can interact with a surface molecule on an antigen-presenting cell selected from the group consisting of CCR1, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8 and XCR1, such as interact with a surface molecule on a human antigen-presenting cell selected from the group consisting of hCCR1, hCCR3, hCCR4, hCCR5, hCCR6, hCCR7, hCCR8 and hXCR1, most preferably wherein the one or more immunostimulatory compounds are selected from the list consisting of macrophage inflammatory protein alpha, including its isoforms, such as mouse CCL3, human CCL3, human CCL3L1, human CCL3L2 and human CCL3L3, CCL4, preferably human CCL4, CCL5, preferably human CCL5, CCL19, preferably human CCL19, CCL20, preferably human CCL20, CCL21, preferably human CCL21, XCL1, preferably human XCL1 and XCL2, preferably humanXCL2.

4. The vector according to any of claims 2 to 3, wherein the one or more immunostimulatory compounds promote activation and/or maturation of antigen-presenting cells, preferably wherein the one or more immunostimulatory compounds can interact with a surface molecule on an antigen-presenting cell which is selected from the group consisting of a receptor of the TNF receptor superfamily, including CD40 (cluster of differentiation 40), CD137 (4-1BB), CD27, RANK, and ICOS (CD278), such as interact with a surface molecule on a human antigen-presenting cell which is selected from the group consisting of a receptor of the human TNF receptor superfamily, including hCD40, hCD137, hCD27, hRANK and hICOS, preferably, wherein the one or more immunostimulatory compounds are selected from the list consisting of CD40L, CD137L, CD70, RANKL and ICOSL, such as hCD40L, hCD137L, hCD70, hRANKL and hICOSL,.

5. The vector according to claim 4, wherein the one or more immunostimulatory compounds a) are cytokines selected from the group consisting of IL-2, IL-10, IL-12, IL-21, TNFα, IFNγ and IL-1β, preferably wherein the one or more immunostimulatory compounds are human cytokines selected from the group consisting of hIL-2, IhL-10, hIL-12, hIL-21, hTNFα, hIFNγ and hIL-1β and/or b)are viral infection sensors, such as MyD88 or TRIF, preferably human viral infection sensors, such as human MyD88 or human TRIF and/or c) can interact with a pattern-recognition receptor on an antigen-presenting cell, such as a Toll-like receptor, including TLR2, TLR4, TLR5 and TLR9 and/or with a receptor on an antigen-presenting cell selected from the group consisting of RAGE, TIM-3, FPR, SREC1, LOX1 and CD91, preferably wherein the one or more immunostimulatory compounds can interact with a pattern-recognition receptor on a human antigen-presenting cell, such as a human Toll-like receptor, including hTLR2, hTLR4, hTLR5 and hTLR9 and/or with a receptor on a human antigen-presenting cell selected from the group consisting of hRAGE, hTIM-3, hFPR, hSREC1, hLOX1 and hCD91, and/or d)are selected from the group consisting of pathogen-associated molecular patterns (PAMPs), such as flagellin, protein damage-associated molecular patterns (DAMPs), such as HMGB1, heat-shock proteins (HSPs), Calrecticulin and Annexin A1, preferably wherein the one or more immunostimulatory compounds are selected from the group consisting of human pathogen-associated molecular patterns (PAMPs), human protein damage-associated molecular patterns (DAMPs), such as hHMGB1, human heat-shock proteins (HSPs), human Calrecticulin and human Annexin A1.

6. The vector according to any of claims 2 to 5, wherein the one or more immunostimulatory compounds promote growth and/or expansion of antigen-presenting cells, preferably wherein the one or more immunostimulatory compounds a) are growth factors, preferably human growth factors and/or b) can interact with a surface molecule on an antigen-presenting cell which is selected from the group consisting of GM-CSF-receptor, FLT-3R, IL-15R and IL-4R, preferably wherein the one or more immunostimulatory compounds can interact with a surface molecule on a human antigen-presenting cell which is selected from the group consisting of hGM-CSF-receptor, hFLT-3R, hIL-15R and hIL-4R and/or c) are selected from the group consisting of GM-CSF, FLT-3L, IL-15 and IL-4, preferably wherein the one or more immunostimulatory compounds are selected from the group consisting of hGM-CSF, hFLT-3L, hIL-15 and hIL-4.

7. The vector according to any of the previous claims, wherein the vector comprises multiple further nucleic acid sequences encoding more than one immunostimulatory compound, such as 2, 3, 4, 5, 6, 7 or 8 immunostimulatory compounds, such as 2, 3, 4, 5, 6, 7 or 8 different immunostimulatory compounds, preferably wherein said multiple immunostimulatory compounds are different immunostimulatory compounds which affect, such as stimulate, antigen-presenting cells differently.

8. The vector according to any of the previous claims, wherein said vector comprises one or more co-expression elements which a) cause the transcription of the first polypeptide and the one or more immunostimulatory compounds on a single transcript and the independent translation into a separate first polypeptide and separate one or more immunostimulatory compounds and are preferably selected from the list consisting of IRES elements or nucleic acid sequences encoding 2A self-cleaving peptides and/or b) cause the transcription of the first polypeptide and the one or more immunostimulatory compounds as separate transcripts and are preferably selected from the list consisting of bidirectional promoters and promoters, wherein the vector comprises a separate promoter for each of the nucleic acid sequences encoding the first polypeptide and the one or more immunostimulatory compounds.

9. The vector according to any of the previous claims, wherein the antigenic unit comprises a) one or more neoantigens or parts thereof, such as neoepitopes, such as

several neoepitopes, such as several neoepitopes which are separated from each other by linkers and optionally further comprises one or more patient-present shared cancer antigens or parts thereof, such as patient-present shared cancer epitopes, such as one or more patient-present shared cancer antigens or parts thereof, such as patient-present shared cancer epitopes or b)one or more shared cancer antigens or parts thereof, such as shared cancer epitopes.

10. The vector according to any of claims 1 to 8, wherein the antigenic unit comprises one or more antigens derived from one or more pathogens and/or parts of such antigens, and wherein if the antigenic unit comprises one or more parts of one or more antigens derived from one or more pathogens, such parts are B cell epitopes, such that the antigenic unit comprises one or more B cell epitopes derived from one or more pathogens or T cell epitopes, such that the antigenic unit comprises one or more T cell epitopes derived from one or more pathogens and wherein the one or more pathogens are preferably selected from the group consisting of viruses, bacteria, fungi and parasites.

11. The vector according to any of the previous claims, wherein the targeting unit is or comprises a moiety that interacts with surface molecules on the antigen-presenting cells, such as surface molecules selected from the group consisting of MHC, HLA, CD14, CD40, CLEC9A, chemokine receptors, such as CCR1, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8 or XCR1 and Toll-like receptors such as TLR-2, TLR-4 or TLR-5, preferably surface molecules selected from the group consisting of HLA, hCD14, hCD40, hCLEC9A, human chemokine receptors, such as hCCR1, hCCR3, hCCR4, hCCR5, hCCR6, hCCR7, hCCR8 or hXCR1 and human Toll-like receptors such as hTLR-2, hTLR-4 or hTLR-5, preferably , wherein the targeting unit comprises or consists of soluble CD40 ligand, CCL4 and its isoforms, CCL5, CCL19, CCL20, CCL21, macrophage inflammatory protein alpha including its isoforms, such as mouse CCL3, human CCL3, human CCL3L1, human CCL3L2 and human CCL3L3, XCL1, XCL2, flagellin, anti-HLA-DP, anti-HLA-DR, anti-pan HLA class II, anti-CD40, anti-TLR-2, anti-TLR-4, anti-TLR-5 or anti-CLEC9A, preferably wherein the targeting unit comprises or consists of soluble hCD40 ligand, hCCL4 and its isoforms, hCCL5, hCCL19, hCCL20, hCCL21, human macrophage inflammatory protein alpha including its isoforms, such human CCL3, human CCL3L1, human CCL3L2 and human CCL3L3, hXCL1, hXCL2, anti-HLA-DP, anti-HLA-DR, anti-pan HLA class II, anti-hCD40, anti-

hTLR-2, anti-hTLR-4, anti-hTLR-5 or anti-hCLEC9 and most preferably wherein the targeting unit comprises or consists of human MIP-1α (LD78β, CCL3L1).

12. The vector according to any of the previous claims, wherein the multimerization unit is selected from the group consisting of dimerization unit, trimerization unit, such as a collagen-derived trimerization unit, such as a human collagen-derived trimerization domain, such as human collagen derived XVIII trimerization domain or human collagen XV trimerization domain or the C-terminal domain of T4 fibritin and tetramerization unit, such as a domain derived from p53 and wherein said multimerization unit optionally comprises a hinge region, such as hinge exon h1 and hinge exon h4.

13. The vector according to claim 12, the multimerization unit is a dimerization unit comprising a hinge region which has the ability to form one or more covalent bonds and is preferably Ig derived and further comprising another domain that facilitates dimerization, preferably wherein the other domain is an immunoglobulin domain, more preferably an immunoglobulin constant domain, more preferably a carboxyterminal C domain derived from IgG, preferably from IgG3 and wherein the dimerization unit further comprises a dimerization unit linker, such as glycine-serine rich linker, such as GGGSSGGGSG (SEQ ID NO: 134) and preferably wherein the dimerization unit linker connects the hinge region and the other domain that facilitates dimerization.

14. The vector according to any of the previous claims, wherein the first nucleic acid sequence encodes a first polypeptide which further comprises a unit liker that connects the antigenic unit to the multimerization unit, and wherein the unit linker is a non-immunogenic linker and/or flexible or rigid linker and/or wherein the first nucleic acid sequence encodes a first polypeptide which further comprises a signal peptide and preferably wherein also the one or more further nucleic acid sequences further encode a signal peptide.

15. The vector according to any of the previous claims, wherein the vector is a viral vector, such as an RNA viral vector or DNA viral vector or a plasmid, such as an RNA plasmid or DNA plasmid.

16. A method of producing a vector as defined in any of the previous claims, the method comprising:

a) transfecting cells *in vitro* with the vector;
b) culturing said cells;
c) optionally, lysing the cells to release the vector from the cells; and
d) collecting and optionally purifying the vector.

17. A host cell comprising a vector as defined in any of claims 1 to 15, such as a host cell selected from the group consisting of prokaryote cells, yeast cells, insect cells, higher eukaryotic cells such as cells from animals or humans.

18. A vector as defined in any of claims 1 to 15 for use as a medicament

19. A pharmaceutical composition comprising the vector as defined in any of claims 1 to 15 and a pharmaceutically acceptable carrier or diluent, wherein the composition optionally further comprises a transfection agent.

20. Use of a vector as defined in any of claims 1 to 15 for the manufacture of a medicament for treating a subject having cancer or having an infectious disease or being in need of prevention of an infectious disease.