Claims

1. An immunogenic construct, the construct being:

(i) a polynucleotide comprising a nucleotide sequence encoding an antigenic unit, wherein the antigenic unit comprises at least 77 SARS-CoV-2 T cell epitopes with amino acid sequences having at least 73% sequence identity to the amino acid sequences SEQ ID NOs: 1-77; or

(ii) a polypeptide comprising the antigenic unit encoded by the nucleotide sequence defined in (i).

2. The immunogenic construct according to claim 1, the construct being:

(i) a polynucleotide comprising a nucleotide sequence encoding an antigenic unit, wherein the antigenic unit comprises at least 77 SARS-CoV-2 T cell epitopes with amino acid sequences having at least 73% sequence identity to the amino acid sequences SEQ ID NOs: 1-77, such as wherein the 77 SARS-CoV-2 T cell epitopes have the amino acid sequences of SEQ ID NOs: 1-77 and wherein the nucleotide sequence further encodes a targeting unit that targets antigen presenting cells and a multimerization unit; or

(ii) a polypeptide encoded by the nucleic acid sequence defined in (i); or

(iii) a multimeric protein consisting of multiple polypeptides as defined in (ii).

3. The immunogenic construct according any of the preceding claims, wherein the antigenic unit further comprises one or more T cell epitopes with amino acid sequences having at least 73% sequence identity to the amino acid sequences SEQ ID NOs: 78-96, such as wherein the one or more T cell epitopes have amino acid sequences of SEQ ID NOs: 78-96, preferably wherein the antigenic unit further comprises all of said T cell epitopes.

4. The immunogenic construct according to claims 1 to 2, wherein the antigenic unit further comprises one or more T cell epitopes with amino acid sequences having at least 73% sequence identity to the amino acid sequences SEQ ID NOs: 97-160, such as wherein the one or more T cell epitopes have amino acid

sequences of SEQ ID NOs: 97-160, preferably wherein the antigenic unit further comprises all of said T cell epitopes.

5. The immunogenic construct according to claim 4, wherein the antigenic unit further comprises one or more T cell epitopes with amino acid sequences having at least 73% sequence identity to the amino acid sequences SEQ ID NOs: 78-96, such as wherein the one or more T cell epitopes have amino acid sequences of SEQ ID NOs: 78-96, preferably all of said the T cell epitopes.

6. The immunogenic construct according to any of the preceding claims, wherein some or all of the T cell epitopes are present as single, discrete epitopes and/or wherein some or all of the T cell epitopes are present as groups of T cell epitopes, wherein each group comprises at least 2 T cell epitopes.

7. The immunogenic construct according to any of the preceding claims, wherein some or all of the T cell epitopes are present as groups of T cell epitopes, wherein each group comprises at least 2 T cell epitopes, preferably, wherein the at least 2 T cell epitopes are derived from the same SARS-CoV-2 protein, preferably from the same part of the same SARS-CoV-2 protein, preferably wherein the T cell epitopes within a group are sequentially arranged, optionally separated by a T cell epitope linker or wherein the T cell epitopes within a group are aligned to form a continuous sequence of amino acids which corresponds to that of the naturally occurring protein the epitopes are derived from.

8. The immunogenic construct according to any of the previous claims, wherein one or more of the T cell epitopes are flanked by amino acids sequences also flanking said epitopes in the naturally occurring protein the epitope is derived from, such as , wherein one or more of the T cell epitopes are flanked by amino acid sequences in the direction of the N-terminus and/or the C-terminus of the epitope, optionally wherein such flanking sequences comprise 1 or more, 2 or more, 3 or more, 4 or more, 5 or more, 6 or more, 7 or more, 8 or more, 9 or more or 10 or more amino acids, preferably 1 to 10 amino acids, e.g. 2 to 8 amino acids or 3 to 7 amino acids or 4 to 5 amino acids.

9. The immunogenic construct according to any of the preceding claims, wherein some or all of the T cell epitopes and/or some or all of the groups of T cell epitopes are separated from each other by T cell epitope linkers, preferably non-immunogenic T cell epitope linkers which are preferably flexible linkers.

10. The immunogenic construct according to any of the preceding claims, wherein the antigenic unit comprises an amino acid sequence having at least 73% sequence identity to an amino acid sequence selected from the group consisting of SEQ ID NOs: 161, 162, 163, 164, 165, 166 and 167, such as wherein the antigenic unit comprises an amino acid sequence selected from the group consisting of SEQ ID NOs: 161, 162, 163, 164, 165, 166 and 167, preferably wherein the antigenic unit comprises the amino acid sequence of SEQ ID NO: 167, more preferably wherein the antigenic unit has an amino acid sequence selected from the group consisting of SEQ ID NOs: 161, 162, 163, 164, 165, 166 and 167, or even more preferably wherein the antigenic unit has the amino acid sequence of SEQ ID NO: 167.

11. The immunogenic construct according to any of claims 2 to 10, wherein the targeting unit is or comprises a moiety that interacts with surface molecules on the antigen presenting cells, preferably wherein the targeting unit is or comprises a moiety that interacts with surface molecules on human antigen presenting cells, such as surface molecules selected from the group consisting of MHC, CD14, CD40, CLEC9A, chemokine receptors, such as CCR1, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8 and 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 and hXCR1 and Toll-like receptors such as hTLR-2, hTLR-4 or hTLR-5, preferably wherein the targeting unit comprises or consists of soluble CD40 ligand, preferably human soluble CD40 ligand, CCL4 and its isoforms, preferably human CCL4 and its isoforms, CCL5, preferably human CCL5, CCL19, preferably human CCL19, CCL20, preferably human CCL20, CCL21, preferably human CCL21, macrophage inflammatory protein alpha including its isoforms, such as mouse CCL3, human CCL3, human CCL3L1, human CCL3L2 and human CCL3L3, XCL1,

preferably human XCL1, XCL2, preferably human XCL2, flagellin, anti-HLA-DP, anti-HLA-DR, anti-pan HLA class II, anti-CD40, preferably anti-human CD40, anti-TLR-2, preferably anti-human TLR-2, anti-TLR-4, preferably anti-human TLR-4, anti-TLR-5, preferably anti-human TLR-5 or anti-CLEC9A, preferably anti-human CLEC9A and most preferably wherein the targeting unit comprises or consists of human MIP-1α (LD78β, CCL3L1).

12. The immunogenic construct according to any of claims 2 to 11, wherein the multimerization unit is selected from the group consisting of dimerization unit, trimerization unit and tetramerization unit and wherein said multimerization unit optionally comprises a hinge region which has the ability to form one or more covalent bonds, preferably wherein the multimerization unit is a dimerization unit and said dimerization unit comprises such hinge region, preferably an Ig derived hinge region, such as derived from human Ig, such as derived from hIgG1 or hIgG2 or hIgG3 or from hIgM, and another domain that facilitates dimerization preferably wherein the other domain is an immunoglobulin domain, preferably an immunoglobulin constant domain, more preferably a carboxyterminal C domain derived from IgG, preferably from IgG3, more preferably from hIgG3, and wherein the dimerization unit further comprises a dimerization unit linker, such as glycine-serine rich linker, such as GGGSSGGGSG, preferably wherein the dimerization unit linker connects the hinge region and the other domain that facilitates dimerization.

13. The immunogenic construct according to any of the preceding claims, wherein the construct is the polynucleotide (i), such as a DNA or RNA, preferably wherein the polynucleotide comprises a nucleotide sequence which further encodes a signal peptide, preferably wherein the signal peptide is the natural leader sequence of the targeting unit.

14. The immunogenic construct according to any of claims 2 to 13, wherein the construct is:

(i) a polynucleotide comprising the nucleotide sequence of SEQ ID NO: 185; or

(ii) a polypeptide that has an amino acid sequence as set forth in SEQ ID NO: 184; or

(iii) a dimeric protein which consists of two polypeptides as defined in (ii).

15. A polynucleotide as defined in any of the preceding claims.

16. A vector comprising the polynucleotide according to claim 15.

17. A polypeptide encoded by the nucleotide sequence as defined in any of claims 1 12 or a multimeric protein consisting of multiple such polypeptides, such as a dimeric protein consisting of two of such polypeptides.

18. The immunogenic construct according to any of claims 1 to 14 or the polynucleotide according to claim 15 or the vector according to claim 16 or the polypeptide or the multimeric protein according to claim 17 for use as a medicament.

19. A pharmaceutical composition or vaccine comprising the immunogenic construct according to any of claims 1 to 14 or the polynucleotide according to claim 15 or the vector according to claim 16 or the polypeptide or the multimeric protein according to claim 171and a pharmaceutically acceptable carrier.

20. Use of the pharmaceutical composition or vaccine according to claim 19 in the manufacture of a medicament for the treatment of a disease caused by SARS-CoV-2, wherein said treatment is a prophylactic treatment or a therapeutic treatment.