Claims

1. RNA comprising at least one coding sequence encoding at least one SARS-CoV-2 spike protein or an immunogenic fragment or immunogenic variant thereof, wherein the SARS-CoV-2 spike protein comprises at least one amino acid substitution, deletion or insertion at a position corresponding to H69; V70; A222; Y453; S477; I692; R403; K417; N437; N439; V445; G446; L455; F456; K458; A475; G476; T478; E484; G485, F486; N487; Y489; F490; Q493; S494; P499; T500; N501; V503; G504; Y505; Q506; Y144; A570; P681; T716; S982; D1118; L18; D80; D215; L242; A243; L244; R246; A701; T20; P26; D138; R190; H655; T1027; S13; W152; L452; R346; P384; G447; G502; T748; A522; V1176; T859; S247; Y248; L249; T250; P251; G252; G75; T76; D950; E154; G769; S254; Q613; F157; R158; Q957; D253; T95; F888; Q677; A67; Q414; N450; V483; G669; T732; Q949; Q1071; E1092; H1101; N1187; W258; T19; V126; H245; S12; A899; G142; E156; K558; and/or Q52 relative to the sequence of SEQ ID NO: 1, wherein the RNA comprises at least one heterologous untranslated region (UTR).

2. The RNA of claim 1, wherein the SARS-CoV-2 spike protein comprises at least one amino acid substitution, deletion or insertion at a position corresponding to H69del; V70del; A222V; Y453F; S477N; I692V; R403K; K417N; N437S; N439K; V445A; V445I; V445F; G446V; G446S; G446A; L455F; F456L; K458N; A475V; G476S; G476A; S477I; S477R; S477G; S477T; T478I; T478K; T478R; T478A; E484Q; E484K; E484A; E484D; G485R; G485S, F486L; N487I; Y489H; F490S; F490L; Q493L; Q493K; S494P; S494L; P499L; T500I; N501Y; N501T; N501S; V503F; V503I; G504D; Y505W; Q506K; Q506H; Y144del; A570D; P681H; T716I; S982A; D1118H; L18F; D80A; D215G; L242del; A243del; L244del; L242del; A243del; L244del; R246I; A701V; T20N; P26S; D138Y; R190S; H655Y; T1027I; S13I; W152C; L452R; R346T; P384L; L452M; F456A; F456K; F456V; E484P; K417T; G447V; L452Q; A475S; F486I; F490Y; Q493R; S494A; P499H; P499S; G502V; T748K; A522S; V1176F; T859N; S247del; Y248del; L249del; T250del; P251del; G252del; R246del; S247del; Y248del; L249del; T250del; P251del; G252del; G75V; T76I; G75V; T76I; D950N; P681R; E154K; G769V; S254F; Q613H; F157L; F157del; R158del; Q957R; D253G; T95I; F888L; Q677H; A67V; Q414K; N450K; V483A; G669S; T732A; Q949R; Q1071H; E1092K; H1101Y; N1187D; W258L; V70F; T19R; Y144T; Y145S; ins145N; R346K; R346S; V126A; H245Y; ins214TDR; S12F; W152R; A899S; G142D; E156G; K558N; and/or Q52R relative to the sequence of SEQ ID NO: 1.

3. The RNA of any one of the preceding claims, wherein the SARS-CoV-2 spike protein comprises at least one amino acid substitution, deletion or insertion at a position in located in the RBD domain (amino acid position aa 319 to aa 541; amino acid positions according to reference SEQ ID NO: 1) or the CND domain (amino acid position aa 329 to aa 529; amino acid positions according to reference SEQ ID NO: 1).

4. The RNA of any one of the preceding claims, wherein the at least one SARS-CoV-2 spike protein comprises or consists of at least one of the amino acid sequences being identical or at least 70%, 80%, 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% identical to any one of SEQ ID NOs: 1, 10, 22738, 22740, 22742, 22744, 22746, 22748, 22750, 22752, 22754, 22756, 22758, 22959-22964, 27087-27109 or an immunogenic fragment or immunogenic variant of any of these.

5. The RNA of any one of the preceding claims, wherein the spike protein (S) is a pre-fusion stabilized spike protein (S_stab) comprising at least one pre-fusion stabilizing mutation, preferably comprising the following amino acid substitutions: K986P and V987P.

6. The RNA of any one of the preceding claims, wherein the RNA is an mRNA, a self-replicating RNA, a circular RNA, or a replicon RNA, preferably the RNA is an mRNA.

7. The RNA of any one of the preceding claims, wherein the RNA comprises a pseudouridine or 1-methylpseudouridine substitution.

8. A composition comprising the RNA as defined in any one of the preceding claims, wherein the composition optionally comprises at least one pharmaceutically acceptable carrier.

9. Composition of claim 8, wherein the composition is a multivalent composition comprising a plurality or at least one further RNA in addition to the RNA as defined in any one of claims 1 to 7.

10. Composition of any one of claims 8 to 9, wherein the RNA is complexed or associated with or at least partially complexed or partially associated with one or more cationic or polycationic compound, preferably cationic or polycationic polymer, cationic or polycationic polysaccharide, cationic or polycationic lipid, cationic or polycationic protein, cationic or polycationic peptide, or any combinations thereof.

11. Composition of claim 10, wherein the RNA is complexed or associated with one or more lipids or lipid-based carriers, thereby forming liposomes, lipid nanoparticles (LNP), lipoplexes, and/or nanoliposomes, preferably encapsulating the at least one RNA.

12. Composition of claims 10 or 11, wherein the RNA is complexed with one or more lipids thereby forming lipid nanoparticles.

13. A vaccine comprising the RNA of any one of claims 1 to 7, and/or the composition of any one of claims 8 to 12.

14. A vaccine of claim 13, wherein the vaccine is a multivalent vaccine comprising a plurality or at least more than one of the RNA as defined in any one of claims 1 to 7, or a plurality or at least more than one of the compositions as defined in any one of claims 8 to 12.

15. A Kit or kit of parts, comprising the RNA of any one of claims 1 to 7, and/or the composition of any one of claims 8 to 12, and/or the vaccine of claim 13 to 14, optionally comprising a liquid vehicle for solubilising, and, optionally, technical instructions providing information on administration and dosage of the components.

16. The RNA of any one of claims 1 to 7, the composition of any one of claims 8 to 12, the vaccine of claim 13 to 14, the kit or kit of parts of claim 15, for use as a medicament.

17. The RNA of any one of claims 1 to 7, the composition of any one of claims 8 to 12, the vaccine of claim 13 to 14, the kit or kit of parts of claim 15, for use in the treatment or prophylaxis of an infection with a coronavirus, preferably a SARS-CoV-2 coronavirus, or of a disorder related to such an infection, preferably COVID-19.