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English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

(54) Title: BROADLY PROTECTIVE BETACORONAVIRUS VACCINES AND COMPOSITIONS

(57) Abstract: The present disclosure relates generally to nucleic acids encoding a polypeptide. The polypeptide comprises a receptor binding domain (RBD), a fusion peptide, or a stem helix, or a combination thereof. The RBD, the fusion peptide, or the stem helix is obtained or derived from a betacoronavirus.



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INTERNATIONAL SEARCH REPORT

International application No PCT/IB2023/000780

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A61K39/12 C07K14/005
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
A61K C07K C12N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO- Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111 592 602 A (INST MICROBIOLOGY CAS) 28 August 2020 (2020-08-28)	1-4, 15, 18, 19, 25-28, 39, 42, 43, 58-60, 62, 63
Y	claims 1-2, 5, 8, 10, 14-17; SEQ ID NOs: 1, 7; examples 12-16	6-11, 13, 14, 16, 17, 20-23, 29-31, 34, 35, 37, 38, 40, 41, 44, 46, 47
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 13 June 2024	Date of mailing of the international search report 12/08/2024
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Kapeller, Anita
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2023/000780

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2022/096899 A1 (AUTOLUS LTD [GB]) 12 May 2022 (2022-05-12) claims 1-3,9-10,15,18-22; page 18 ln 3, page 25 -----	1-4,15, 18, 25-28, 39,42, 58,60, 62,63
X	WO 2021/159130 A2 (MODERNATX INC [US] ET AL.) 12 August 2021 (2021-08-12) claims 1,20; SEQ ID NO:8 -----	1-3, 24-27, 48-54, 58-63
X	WO 2022/262142 A1 (NAT VACCINE AND SERUM INSTITUTE NVSI [CN]) 22 December 2022 (2022-12-22) claims 1,11,12,46-53; SEQ ID NO 4	1-4,18, 25-28, 42,58, 60,62,63 6-11,13, 14,16, 17, 20-23, 29-31, 34,35, 37,38, 40,41, 44,46,47
X	WO 2021/168875 A1 (UNIV SUN YAT SEN [CN]) 2 September 2021 (2021-09-02) claims 1-8; example 1; SEQ ID NOs: 1-7 -----	1-3,12, 18, 25-27, 36,42, 62,63
X	WO 2022/197624 A1 (MODERNATX INC [US]) 22 September 2022 (2022-09-22) claims 1,26-30,39-45; page 88 3 -----	1-4,18, 49-54, 58-63
X	WO 2021/159040 A2 (MODERNATX INC [US]) 12 August 2021 (2021-08-12) claims 3,11,13,24,26,64-74,81-83 ----- -/--	1-3,18, 49-54, 58-63

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>BERGUER PAULA M ET AL: "Covalent coupling of Spike's receptor binding domain to a multimeric carrier produces a high immune response against SARS-CoV-2", SCIENTIFIC REPORTS, vol. 12, no. 1, 22 January 2022 (2022-01-22), XP093170865, US ISSN: 2045-2322, DOI: 10.1038/s41598-021-03675-0 Retrieved from the Internet: URL:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8758758/pdf/41598_2021_Article_3675.pdf> abstract; page 10 5, page 8 L - page 9 1; Figure 1</p>	1-3, 25-27, 62,63
X	<p>DAI LIANPAN ET AL: "A Universal Design of Betacoronavirus Vaccines against COVID-19, MERS, and SARS", CELL, ELSEVIER, AMSTERDAM NL, vol. 182, no. 3, 28 June 2020 (2020-06-28), pages 722-733, XP086239965, ISSN: 0092-8674, DOI: 10.1016/J.CELL.2020.06.035 [retrieved on 2020-06-28] page 5 rc 2 - page 7 lc 2; page 18 2; Figures 2,4</p>	1-3, 25-27, 62,63
X	<p>US 2022/401550 A1 (SIMON-LORIERE ETIENNE [FR] ET AL) 22 December 2022 (2022-12-22) claims 1,37,52,54; [0063-0064]</p>	1-3,18, 49-61
Y	<p>SHAFQAT AREEZ ET AL: "SARS-CoV-2 epitopes inform future vaccination strategies", FRONTIERS IN IMMUNOLOGY, vol. 13, 25 November 2022 (2022-11-25), XP093170873, Lausanne, CH ISSN: 1664-3224, DOI: 10.3389/fimmu.2022.1041185 Retrieved from the Internet: URL:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9732895/pdf/fimmu-13-1041185.pdf> page 8 rc 1-2</p>	6-11,13, 14,16, 17, 20-23, 29-31, 34,35, 37,38, 40,41, 44,46,47

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Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
 - a. forming part of the international application as filed.
 - b. furnished subsequent to the international filing date for the purposes of international search (Rule 13^{ter}.1(a)).
 accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this report has been established to the extent that a meaningful search could be carried out without a WIPO Standard ST.26 compliant sequence listing.
3. Additional comments:

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:
1 - 63 (partially)

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-63 (partially)

Nucleic acids encoding betacoronavirus antigens comprising a receptor binding domain (RBD) of the spike protein.

2. claims: 1-63 (partially)

Nucleic acids encoding betacoronavirus antigens comprising a fusion peptide (FP) of the spike protein

3. claims: 1-63 (partially)

Nucleic acids encoding betacoronavirus antigens comprising a stem helix (SH) of the spike protein

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 111592602	A	28-08-2020	AU 2020429019 A1
			BR 112022015707 A2
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