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A61K 39/00 (2006.01)

A61P 31/14 (2006.01)

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English

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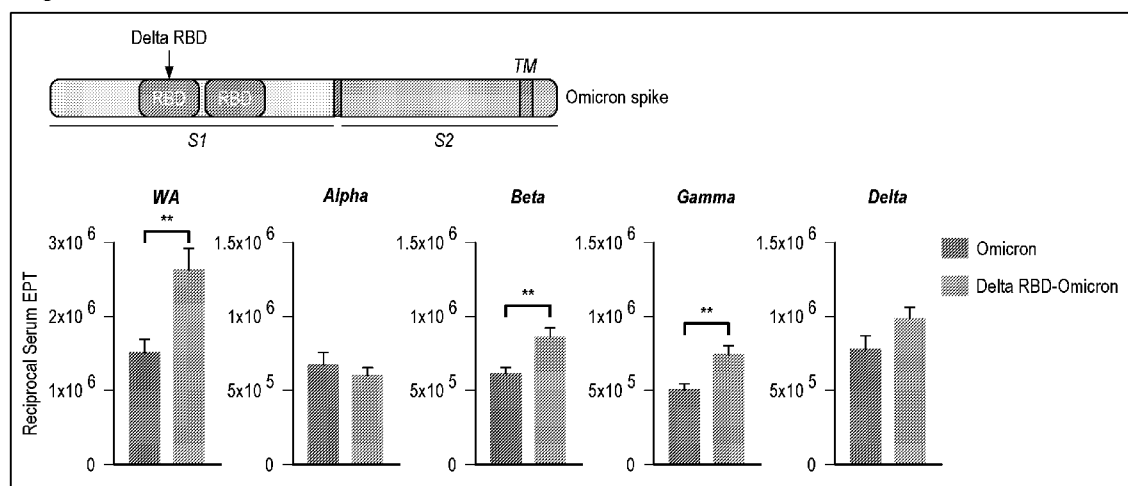
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,

(54) Title: NUCLEIC ACID MOLECULES AND VACCINES COMPRISING SAME FOR THE PREVENTION AND TREATMENT OF CORONAVIRUS INFECTIONS AND DISEASE

Figure 19A



(57) Abstract: The present disclosure relates, inter alia, to nucleic acid molecules and compositions, pharmaceutical compositions, vaccines comprising such nucleic acid molecules for preventing or treating coronavirus infections and diseases associated therewith, as well as methods for administering same.



DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, 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.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

24 November 2022 (24.11.2022)

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2022/019834

A. CLASSIFICATION OF SUBJECT MATTER INV. A61K39/12 A61P31/14 A61K39/00 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 A61P 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 <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td> SAHIN UGUR ET AL: "COVID-19 vaccine BNT162b1 elicits human antibody and T1 T cell responses", NATURE, NATURE PUBLISHING GROUP UK, LONDON, vol. 586, no. 7830, 30 September 2020 (2020-09-30), pages 594-599, XP037276953, ISSN: 0028-0836, DOI: 10.1038/S41586-020-2814-7 [retrieved on 2020-09-30] figure all; example all ----- -/- </td> <td>6, 32-76</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	SAHIN UGUR ET AL: "COVID-19 vaccine BNT162b1 elicits human antibody and T1 T cell responses", NATURE, NATURE PUBLISHING GROUP UK, LONDON, vol. 586, no. 7830, 30 September 2020 (2020-09-30), pages 594-599, XP037276953, ISSN: 0028-0836, DOI: 10.1038/S41586-020-2814-7 [retrieved on 2020-09-30] figure all; example all ----- -/-	6, 32-76
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☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.								
* Special categories of cited documents : <table border="0"> <tr> <td style="vertical-align: top;"> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="vertical-align: top;"> "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 "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 "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 "&" document member of the same patent family </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"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 "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 "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 "&" document member of the same patent family				
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"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 "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 "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 "&" document member of the same patent family							
Date of the actual completion of the international search		Date of mailing of the international search report						
23 August 2022		26/10/2022						
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 Fellows, Edward						

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2022/019834

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	POLACK FERNANDO P. ET AL: "Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine", THE NEW ENGLAND JOURNAL OF MEDICINE, [Online] vol. 383, no. 27, 31 December 2020 (2020-12-31), pages 2603-2615, XP055820495, US ISSN: 0028-4793, DOI: 10.1056/NEJMoa2034577 Retrieved from the Internet: URL:https://pro.biontech.de/files/Polack_F_et_al.pdf> [retrieved on 2022-08-22] figure all; example all -----	6, 32-76

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2022/019834

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:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☒ furnished subsequent to the international filing date for the purposes of international search only:
 - ☒ in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
2. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
3. Additional comments:

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2022/019834

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.: **1-5, 7-31 (completely); 6, 32-76 (partially)**
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:
see FURTHER INFORMATION sheet PCT/ISA/210

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.:
6, 32-76 (all 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: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.1 and related subject-matter.

2. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.2 and related subject-matter.

3. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.3 and related subject-matter.

4. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.4 and related subject-matter.

5. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.5 and related subject-matter.

6. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.6 and related subject-matter.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

7. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.7 and related subject-matter.

8. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.8 and related subject-matter.

9. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.9 and related subject-matter.

10. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.10 and related subject-matter.

11. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.11 and related subject-matter.

12. claims: 6, 32-76(all partially)

A nucleic acid molecule comprising a nucleic acid sequence encoding at least a portion of a viral spike protein wherein the nucleic acid sequence comprises at least one RBD-encoding sequence of a coronavirus spike protein defined by SEQ ID No.12 and related subject-matter.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 1-5, 7-31(completely); 6, 32-76(partially)

In response to the PCT invitation to provide informal clarification dated 19.07.2022, the Applicant filed the letter dated 12.08.2022 wherein it is requested that the ISA focus on claims 6, 32, 37 and 64 in the context of claim 1 wherein said claims only concern the nucleic acid sequences as defined by SEQ ID Nos. 1-12.

The ISA maintains its initial arguments detailed in the letter dated 19.07.2022 and therefore, in view of the above response, will perform a search based on claims 6, 32, 37 and 64 in the context of the nucleic acid sequences as defined by SEQ ID Nos. 1-12 as well as the claims dependent thereupon i.e. claims 33-36, 38-63 and 65-76.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) PCT declaration be overcome.