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(71) Applicant *(for all designated States except US)*: **NOVAVAX INC.** [US/US]; 9920 Belward Campus Drive, Rockville, Maryland 20850 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SMITH, Gale** [US/US]; c/o Novavax Inc., 9920 Belward Campus Drive, Rockville, Maryland 20850 (US). **LIU, Ye** [US/US]; c/o Novavax Inc., 9920 Belward Campus Drive, Rockville, Maryland 20850 (US).

(74) Agents: **TUSCAN, Michael, S.** et al.; Cooley LLP, 777 6th Street, N.W., Suite 1100, Washington, District of Columbia 20001 (US).

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[Continued on next page]

(54) Title: RABIES GLYCOPROTEIN VIRUS-LIKE PARTICLES (VLPs)

(57) Abstract: The present invention is generally related to virus-like particles (VLPs) comprising rabies virus (RV) glycoproteins (G proteins) and methods for making and using them, including immunogenic compositions such as vaccines for the treatment and/or prevention of rabies virus infection.

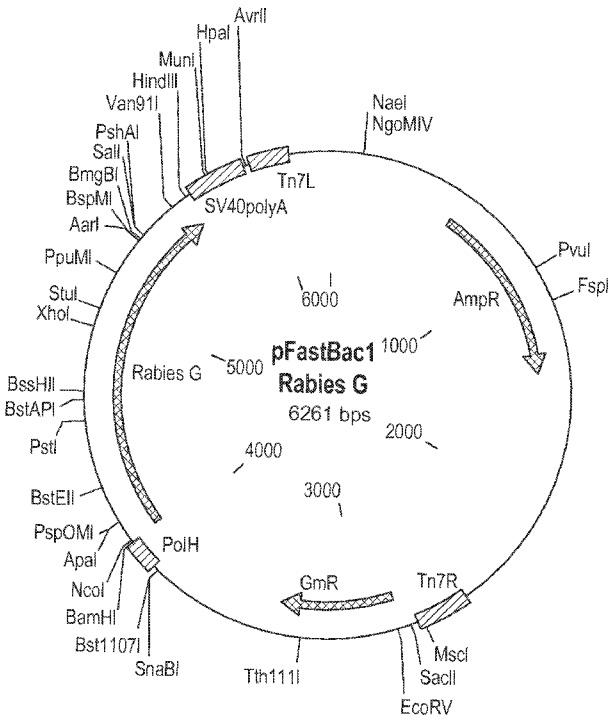

FIG. 1

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Published:

— *with international search report (Art. 21(3))*

— *with sequence listing part of description (Rule 5.2(a))*

(88) **Date of publication of the international search report**:
14 March 2013

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61K 9/127; A61K 39/205 (2012.01)
USPC - 424/450; 424/224.1
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)
USPC- 424/450; 424/224.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC- 424/812

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(PGPB,USPT,USOC,EPAB,JPAB); Google Patents; Google Scholar: rabies virus, Lyssavirus genus, Rhabdoviridae, virus like particle, micelle, glycoprotein, immunosome, VLP, matrix protein, influenza, H5N1, A/Indonesia/5/05, Newcastle Disease Virus, NDV, VLP release, Lipoparticle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	Perrin, et.al. Rabies immunosome (subunit vaccine) structure and immunogenicity. Pre- and post-exposure protection studies. Vaccine. 1985, 3(3):325-332; Abstract; Fig 2C; pg 329, Table 1; pg 331, col 2	1, 14, 16 ---------- 2, 18, 21, 25
Y	GenBank Direct Submission ACR39382.1. Glycoprotein [Rabies virus]. (31 May 2009) [Retrieved from the Internet 07 May 2012: <http://www.ncbi.nlm.nih.gov/protein/ACR39382.1>]	2, 4, 18, 21, 25
X	Sureau, et al. The use of immunosome technology for vaccines against rabies and other viral diseases. Eur J Epidemiol. 1989, 5(3):275-278; Abstract	1-2
X -- Y	US 2010/0167341 A1 (You, et al.) 01 July 2010 (10.07.2010) claim 1; para [0048], [0049], [0132]	3, 4, 6
X -- Y	US 2010/0143406 A1 (SMITH, et al.) 10 June 2010 (10.06.2010) Abstract, para [0011], [0029], [0096], Fig 1	3, 5, 7 --------- 8-10
Y	Kang, et al. Influenza Virus-Like Particles as Pandemic Vaccines. Current Topics in Microbiology and Immunology. Vaccines for Pandemic Influenza 2009, 333(3):269-289; pg 274, Fig 4 and its legend; pg 278, last para	8-10

☒ Further documents are listed in the continuation of Box C. ☒

* Special categories of cited documents:
"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
03 May 2012 (03.05.2012)	24 OCT 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

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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.
Y	US 2009/0263420 A1 (Morrison, et al.) 22 October 2009 (22.10.2009) Abstract, para [0010], [0012], [0059]	11
X	US 5,667,782 A (Roy) 16 September 1997 (16.09.1997) Abstract, claim 3; col 3, ln 1-5	3
X	US 2005/0064389 A1 (Jacob, et al.) 24 March 2005 (24.03.2005) Abstract, [0007]-[0010], [0065]-[0071], [0101]	3
X	US 2004/0014708 A1 (Plebanski) 22 January 2004 (22.01.2004)	1, 3
A	Roy, et al. Virus-like particles as a vaccine delivery system: myths and facts. Hum Vaccin. 2008, 4(1):5-12	3-11
A	Scheerlinck, et al. Virus-sized vaccine delivery systems. Drug Discov Today 2008, 13(19-20):882-887	1-11, 14, 16, 18, 21, 25
A	US 2009/0010963 A1 (Wu, et al.) 08 January 2009 (08.01.2009) Abstract	3-11
A	US 2010/0166769 A1 (Hsiao, et al.) 01 July 2010 (01.07.2010) Abstract	3-11
A	WO 2010/040023 A2 (CHATTERJEE, et al.) 08 April 2010 (08.04.2010) Abstract	3-11
A	US 2010/0267116 A1 (Kawaoka, et al.) 21 October 2010 (21 October 2010) Abstract	3-11
A	Benmansour, et a. Antigenicity of rabies virus glycoprotein. J Virol. 1991, 65(8):4198-4203; Abstract	1-11, 14, 16, 18, 21, 25
A	Marissen, et al. Novel rabies virus-neutralizing epitope recognized by human monoclonal antibody: fine mapping and escape mutant analysis. J Virol. 2005, 79(8):4672-8.	1-11, 14, 16, 18, 21, 25
A	Swenson, et al. Generation of Marburg virus-like particles by co-expression of glycoprotein and matrix protein. FEMS Immunol Med Microbiol. 2004, 40(1):27-31	6-11
X,P	US 2010/0291040 A1 (Lobel, et al.) 18 November 2010 (18.11.2010) Abstract	1-11, 14, 16, 18, 21, 25

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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.: 12-13, 15, 17, 19-20, 22-24, 26, 33
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:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: claims 1-11, 14, 16, 18, 21, 25, drawn to a purified micelle compnsing one or more rabies VIrus (RV) glycoproteins (G proteins), and a method of using said micelle.

Group II: claims 27-32, drawn to an isolated nucleic acid encoding a RV G protein of SEQ ID NO: 2.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

********** See Supplemental Sheet to continue **********

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 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.:
1-11, 14, 16, 18, 21, 25

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.

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********** Supplemental Sheet **********

In Continuation of Box III. Observations where unity of invention is lacking:

The inventions of Group II do not include the inventive concept of a purified micelle compnsing one or more rabies Vlrus (RV) glycoproteins (G proteins, as required by Group I.

The inventions of Group I do not include the inventive concept of an isolated nucleic acid encoding a RV G protein of SEQ ID NO: 2, as required by Gro II.

In addition, a RV G protein of SEQ ID NO: 2 was known in the art at the time of the invention, as evidenced by US 2005/0064389 A1 to TORDO, et al. (SEQ ID NO 24, 100% identity).

Groups I-II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.