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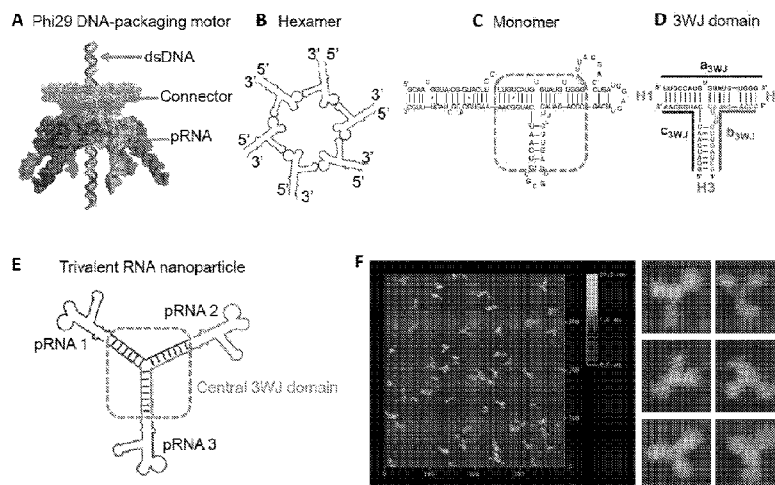
(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE,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

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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))

[Continued on next page]

(54) **Title:** PRNA MUTLIVALENT JUNCTION DOMAIN FOR USE IN STABLE MULTIVALENT RNA NANOPARTICLES**Figure 1**

(57) **Abstract:** Trifurcate RNA junction domains derived from phi29 pRNA are described that assemble with high affinity and that are stable in vitro and in vivo. Further expansion of trifurcated RNA domains to multiple way junction scaffolds via creative designs enable an array of toolkit to construct nanoparticle architectures with diverse shapes and angles. The scaffolds can be used to form RNA nanoparticles having a wide variety of uses, including promotion of RNA crystallization, creation of RNA aptamer with high affinity to mimic antibody, delivery of therapeutic and/or diagnostic agents such as biologically active RNA-based moieties, including siRNA, ribozymes, aptamers, and others.



— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))* — *with sequence listing part of description (Rule 5.2(a))*

Published:

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18 April 2013

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/040823**A. CLASSIFICATION OF SUBJECT MATTER***C12Q 1/68(2006.01)i, C12N 15/11(2006.01)i*

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)

C12Q 1/68; C12N 5/00; C07H 21/02; C12N 7/00; A61K 31/7088; C12N 15/11; A61K 38/14

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: KOMPASS, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SHU, Y., et al., Assembly of multifunctional Phi29 pRNA Nanoparticles for specific delivery of SiRNA and other therapeutics to targeted cells, Methods, Vol. 54, pp. 204-214, 12 February 2011 See abstract; line 17 of left column - line 3 of right column of page 205, lines 3-24 of left column of page 206, line 1 of left column - line 4 of right column of page 207, line 10 of left column - line 21 of right column of page 209;	1-6,9-14,19-21 ,24-33
A	figures 1-8.	15-18,22,23
A	US 2010-0003753 A1 (GUO, P.) 07 January 2010 See entire document.	1-6,9-33
A	US 2008-0064647 A1 (GUO, P. et al.) 13 March 2008 See entire document.	1-6,9-33
A	US 2009-0203131 A1 (REINEKE, T. M. and JONES, W. K.) 13 August 2009 See entire document.	1-6,9-33
A	US 2011-0112040 A1 (LIU, DAVID R. et al.) 12 May 2011 See entire document.	1-6,9-33

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* 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 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

25 JANUARY 2013 (25.01.2013)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/040823**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.: 7, 8, 34-38
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:

Claims 2, 13, 14 relates to multivalent RNA junction scaffold, multivalent RNA, but claims 7, 8, 34-38, dependent on claims 2, 13, 14, relate to multivalent RNA nanoparticle, trifurcate junction domain or four way junction motif. As claims 7, 8, 34-38 does not clearly define the matter for which protection is sought, this claims do not meet the requirement of PCT Article 6.
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:

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 fee, this Authority did not invite payment of any additional fee.
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.:

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/040823

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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