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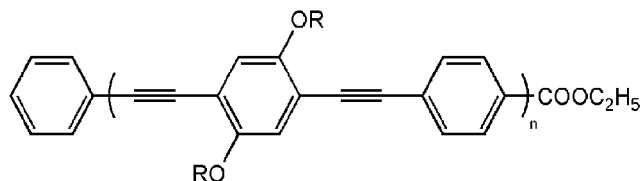


Fig. 1

(57) Abstract: Novel compounds generally referred to herein as cationic oligomeric phenylene ethynylenes (OPEs), methods of synthesizing OPEs and various uses for the OPEs are described. The compounds can be synthesized in both symmetrical (S-OPE) and non-symmetrical (N-OPE) forms. Suitable uses include sensor and biocidal applications. Reusable structures incorporating the OPEs that are able to capture and release biological species of interest are also described.



WO 2009/158606 A3

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2009/048838****A. CLASSIFICATION OF SUBJECT MATTER***C07C 211/63(2006.01)i, C07C 69/76(2006.01)i, A01N 33/12(2006.01)i, A01N 33/06(2006.01)i, C12M 1/00(2006.01)i, C12Q 1/00(2006.01)i, G01N 27/00(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)

IPC : C07C 211/63, C07C 69/76, A01N 33/12, A01N 33/06, V12M 1/00, C12Q 1/00, G01N 27/00

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)

eKOMPASS(KIPO internal), PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	TANG Y. et al. "Synthesis, Self-Assembly, and Photophysical Behavior of Oligo Phenylene Ethynyls: From Molecular to Supramolecular Properties". <i>Langmuir</i> . 2009, Vol. 25, pages 21-25 (published on web 12/11/2008) See the abstract; Introduction; and Scheme 1.	1-8, 10-23, 25-31, 33-40, 42, 43, 46-53, 57-64, 66
X	GEORGE W. N. et al. "Amplified fluorescence quenching in high ionic strength media". <i>Soft Matter</i> . 2007, Vol. 3, pages 1381-1387 See the abstract; Introduction; and figure 1.	5, 10, 14, 15, 15(1), 20-23, 25-31, 37-40, 42, 43, 50-53, 61-64, 66
A		1-4, 6-9, 11-13, 16-19, 24, 33-36, 41, 46-49, 54, 57-60, 65
X	FAN, Qu-Li et al. "Water-Soluble Cationic Poly(p-phenyleneethynylene)s (PPEs): Effects of Acidity and Ionic Strength on Optical Behavior". <i>Macromolecules</i> . 2005, Vol. 38, pages 2927-2936 See the abstract; Introduction; and Scheme 1 and 2.	5, 10, 14, 15, 15(1), 20-23, 25-31, 37-40, 42, 43, 50-53, 61-64, 66
A	(Note: 1. Claim "38" described after claim 65 is regarded as claim 66. 2. Claim 15 is found twice, and thus second claim 15 is renumbered as claim 15(1).)	1-4, 6-9, 11-13, 16-19, 24, 33-36, 41, 46-49, 54, 57-60, 65

 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 APRIL 2010 (28.04.2010)

Date of mailing of the international search report

**30 APRIL 2010 (30.04.2010)**

Name and mailing address of the ISA/KR

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**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2009/048838****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:

This ISA found multiple inventions as follows:

Group I, claims 1-31, 33-43, 46-54, 57-66, is directed to a cationic oligo phenylene ethylene having the structure represented in the claims, and a DNA sensor, a method, and a (functional) material characterized by including or using the cationic oligo phenylene ethylene. (Note: Even if claim 66 is missing in the claims, "claim 38" described after claim 65 is regarded as claim 66 during the examination.)

Group II, claim 32, is directed to a functional material comprising a cationic oligo phenylene ethylene of which the structure is not defined specifically. (Continued on Supplemental Box.)

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.: Group I

**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**

International application No.

**PCT/US2009/048838**

(Box No. III)

Group III, claims 44 and 45, is directed to a material comprising a stimuli responsive polymer and an oligomeric unit.

Group IV, claims 55 and 56, is directed to a method comprising: providing a functional material that can be switched between active and inactive forms.

Since the above mentioned groups of claims do not share any of the technical features identified, a technically special relationship between the inventions does not exist.

Accordingly the claims do not relate to one invention or to a single general inventive concept. (Rule 13.1 and 13.2 PCT)