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(54) Title: PHOTORESPONSIVE CHALCOGENIDE HYBRID ORGANIC/INORGANIC POLYMER FILMS

(57) Abstract: The present invention provides certain CHIP films and coatings, as well as the preparation and uses thereof.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 19/54368

A. CLASSIFICATION OF SUBJECT MATTER

IPC - C08G 75/14; C08L 81/04; G02B 1/04 (2020.01)

CPC - C08G 75/14; C08L 81/04; G02B 1/04

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)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/0105649 A1 (Arizona Board of regents on behalf of University of Arizona), 19 April 2018 (19.04.2018) Abstract; Figure 2; para [0005], para [0065], para [0015], para [0054], para [0049] and entire document	1, 11/1, 12, 14, 15
A	US 2018/0208686 A1 (Arizona Board of regents on behalf of University of Arizona), 26 July 2018 (26.07.2018) Abstract, para [0018]-[0031]	1, 11/1, 12, 14, 15
P/X	WO 2018/183702 A1 (Arizona Board of regents on behalf of University of Arizona), 4 October 2018 (04.10.2018) Abstract; para [0021]-[0029]	1, 11/1, 12, 14, 15
A	US 2003/0189758 A1 (Baer et al.) 9 October 2003 (09.10.2003) Abstract; para [0010], Figure 8;	1, 11/1, 12, 14, 15
A	US 6,265,708 B1 (Tanaka et al.) 24 July 2001 (24.07.2001) Abstract; col 2 ln 40-col 4 ln 60	1, 11/1, 12, 14, 15

☐ 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

"D" document cited by the applicant in the international application

"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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 19/54368

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.: 13, 16
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 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 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(in part), 12, 14-15

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/US 19/54368

-----continued from Box III-----

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. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1, 11(in part),12, 14-15 is directed towards photoresponsive medium comprising one or more CHIPS, wherein the photoresponsive medium changes its refractive index upon the application of ultraviolet radiation between 350-400nm

Group II: Claims 2-6, 17-19 is directed towards a method of preparing a photopatterned, unstructured polymer thin film, said method comprising depositing on to a substrate the unstructured polymer film comprising one or more CHIPS and exposing said film to ultraviolet radiation to form an exposed CHIP film.

Group III: Claims 7-10, 11 (in part), is directed towards a multilayer device comprising at least one layer of chalcogenide-based polymer (e.g. a CHIP material), wherein said device comprises: (A) at least a portion of the area of the layer which has been photoexposed by a method comprising using a mask or a maskless lithography system to create a photopattern, which comprises an unexposed region and an photoexposed region, thereby fabricating at least one layer of said polymer so as to create an optical waveguide, wherein said photoexposed region results in crosslinking of the polymer (or CHIP material), rendering said region insoluble in solvents that can rinse away the uncured polymer (or material), resulting in a physically defined waveguide core; and (B) An optical waveguide made using said method (A).

The inventions listed as Groups I-III 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:

Special Technical Features:

Group I requires wherein the photoresponsive medium changes its refractive index upon the application of ultraviolet radiation between 350-400nm, not required by groups II, III.

Group II requires a method of preparing a photopatterned, unstructured polymer thin film, said method comprising depositing on to a substrate the unstructured polymer film comprising one or more CHIPS and exposing said film to ultraviolet radiation to form an exposed CHIP film , not required by groups I and III

Group III requires a multilayer device comprising at least one layer of chalcogenide-based polymer (e.g. a CHIP material), wherein said device comprises: (A) at least a portion of the area of the layer which has been photoexposed by a method comprising using a mask or a maskless lithography system to create a photopattern, which comprises an unexposed region and an photoexposed region, thereby fabricating at least one layer of said polymer so as to create an optical waveguide, wherein said photoexposed region results in crosslinking of the polymer (or CHIP material), rendering said region insoluble in solvents that can rinse away the uncured polymer (or material), resulting in a physically defined waveguide core; and (B) An optical waveguide made using said method (A), not required by groups I and II

Shared Technical Features:

Groups I-III share the common feature of a towards photoresponsive medium comprising one or more CHIPS. However, these shared technical features do not represent a contribution over prior art, because the shared technical feature is anticipated by US 2018/0208686 A1 to The Arizona Board of Regents on behalf of the University of Arizona(hereinafter Regents). Regents discloses a photoresponsive (para [0110], Stimuli , such as thermal , light , or another form of stimuli , can induce dynamic activation of S S bonds) medium comprising one or more CHIPS (para [0018], functional sulfur polymers having a high molecular weight and sulfur content; and instant application, para [0009], The term "CHIP" is used herein to refer to a chalcogenide hybrid inorganic/organic polymer).

As the shared technical features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups. Therefore, Groups I-III lack unity under PCT Rule 13.

Item 4 (contd.): Claims 13,16 are unsearchable because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).