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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, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, 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.

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(54) Title: HEAVY-ATOM FREE SENSITIZERS FOR TRIPLET-TRIPLET ANNIHILATION UPCONVERSION SYSTEMS

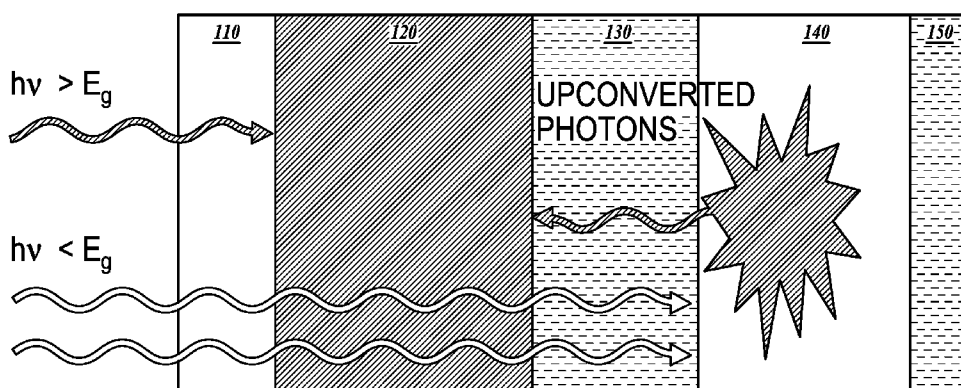


FIG. 1

(57) Abstract: The present disclosure features photon upconversion systems, including a sensitizer and an emitter, wherein the sensitizer absorbs an energy from an incident radiation, and the emitter accepts the energy from the sensitizer via triplet-triplet energy transfer, and emits at a lower wavelength than the incident radiation via a triplet-triplet annihilation process. The present disclosure also features devices including the photon upconversion systems.



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- *with international search report (Art. 21(3))*
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US21/51467

A. CLASSIFICATION OF SUBJECT MATTER

IPC - C07C 35/21; C07C 13/28; C09B 57/00 (2021.01)

CPC - C07C 13/28; C09B 57/00; C09B 69/00; C07C 35/21

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.
Y	(CHENG, YY et al.) On the efficiency limit of triplet-triplet annihilation for photochemical upconversion. <i>Physical Chemistry Chemical Physics</i> , Vol. 12, 2010, DOI: 10.1039/b913243k, pages 66-71; abstract; page 67, first column, fourth paragraph; page 67, second column, fourth paragraph; page 68, figure 2	1-4
Y	(TEMBO, M) Enhancement of Photoconversion Efficiency of P3HT:PCBM Polymer Solar Cell Using Squarylium III Dye. 2016, [retrieved on 2022-05-04]. Retrieved from the Internet URL: http://dspace.unza.zm/bitstream/handle/123456789/4773/Main%20Document.pdf?sequence=1&isAllowed=y , page 1-57; abstract; page 19, figure 7; page 31, figure 10; page 33, first paragraph	1-4
A	(DUAN, P et al.) Photon Upconversion in Supramolecular Gel Matrices: Spontaneous Accumulation of Light-Harvesting Donor-Acceptor Arrays in Nanofibers and Acquired Air Stability. <i>Journal of the American Chemical Society</i> , Vol. 137, No. 5, 19 January 2015, DOI: 10.1021/ja511061h, pages 1887-1894; entire publication	1-4

 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

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US21/51467

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.: 5-33
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:

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.:

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.