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- with international search report (Art. 21(3))
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- with sequence listing part of description (Rule 5.2(a))

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14 December 2023 (14.12.2023)

(54) Title: BIOLUMINESCENCE-TRIGGERED PHOTOCATALYTIC LABELING

(57) Abstract: Provided herein are systems, methods, and compositions for bioluminescence-triggered catalysis of bioorthogonal labeling chemistries in a proximity dependent manner. In particular, provided herein are bioluminescent proteins or complexes, luminophore substrates thereof, photocatalysts or photosensitizers, activatable labels, and systems thereof, and methods of catalytically activating the activatable labels via bioluminescence-triggered catalysis.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2023/021057

A. CLASSIFICATION OF SUBJECT MATTER INV. C09K11/06 A61K49/00 G01N31/00 G01N33/58 A61K41/00 A61K47/54 G01N33/542 ADD. 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) C09K A61K G01N 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) EPO-Internal, COMPENDEX, INSPEC, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LINDBERG ERIC ET AL: "Luciferase-induced photoreductive uncaging of small-molecule effectors", NATURE COMMUNICATIONS, vol. 9, no. 1, 2018, XP093076216, figures 1, 5	1, 3-9, 18-86
X	LIU WEILONG ET AL: "Photocatalysis in Chemical Biology: Extending the Scope of Optochemical Control and Towards New Frontiers in Semisynthetic Bioconjugates and Biocatalysis", HELVETICA CHIMICA ACTA, vol. 104, no. 12, 2021, XP093077399, figure 4D	1, 3-5, 21-23, 25-32, 40-49, 59, 61-63, 73-75, 79-86
☒ 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 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 31 August 2023		Date of mailing of the international search report 02/11/2023
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Gunster, Marco

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2023/021057

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SIMONA ANGERANI ET AL: "Visible Light Photoredox Catalysis Using Ruthenium Complexes in Chemical Biology", CHEMISTRY - A EUROPEAN JOURNAL, vol. 25, no. 27, 2019, pages 6661-6672, XP071848710,	1, 3-5, 21-23, 25-32, 40-49, 59, 61-63, 73-75, 79-86
A	figure 6 figure 10 -----	51
A	RYU KEUN AH ET AL: "Interrogating biological systems using visible-light-powered catalysis", NATURE REVIEWS CHEMISTRY, vol. 5, no. 5, 2021, pages 322-337, XP037450484, figure 8 -----	52
A	JACOB B. GERI ET AL: "Microenvironment mapping via Dexter energy transfer on immune cells", SCIENCE, vol. 367, no. 6482, 2020, pages 1091-1097, XP055769280, figures 1-3 -----	52

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2023/021057

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed.
 - b. ☐ furnished subsequent to the international filing date for the purposes of international search (Rule 13*ter*.1(a)).

☐ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.
2. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this report has been established to the extent that a meaningful search could be carried out without a WIPO Standard ST.26 compliant sequence listing.
3. Additional comments:

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2023/021057

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:

see additional sheet

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 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, 9, 42-60, 81-86 (completely); 3-8, 18-41, 61-80 (partially)

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 9, 42-60, 81-86(completely); 3-8, 18-41, 61-80(partially)

System comprising: (a) a bioluminescent protein, (b) a luminophore, (c) a photocatalyst, and (d) an activatable label, as well as methods and cells comprising said system.

2. claims: 10-17(completely); 2-8, 18-20, 40, 41, 61-80, 87, 88(partially)

System comprising: (a) a bioluminescent protein, (b) a luminophore, (c) a photocatalyst; wherein the bioluminescent protein is circularly permuted or is constituted by structurally complementary components.

3. claims: 2, 3, 21-32, 40, 41, 61-80, 87, 88(all partially)

System comprising: (a) a bioluminescent protein, (b) a luminophore, (c) a photocatalyst; wherein the photocatalyst is irridium- or ruthenium-based.

4. claims: 2, 3, 33-41, 61-80, 87, 88(all partially)

System comprising: (a) a bioluminescent protein, (b) a luminophore, (c) a photocatalyst; wherein the photocatalyst is an organic photoredox catalyst.
