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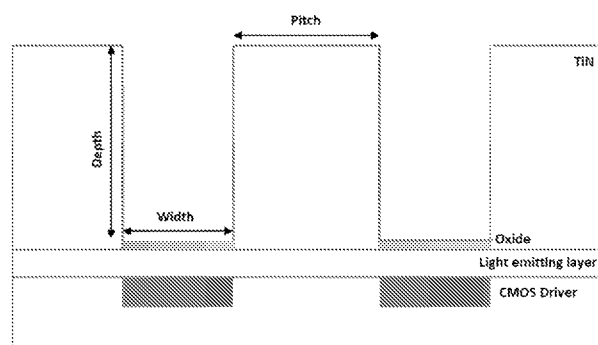
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10 February 2022 (10.02.2022)

(54) Title: DEVICES AND METHODS FOR LIGHT-DIRECTED POLYMER SYNTHESIS

FIG. 2A



(57) Abstract: Provided herein are compositions, devices, systems and methods for generation and use of biomolecule-based information for storage. Further provided are devices comprising addressable LED arrays to control polymolecule synthesis (deprotection, extension, or cleavage, etc.) The compositions, devices, systems and methods described herein provide improved storage, density, and retrieval of biomolecule-based information.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 21/40567

A. CLASSIFICATION OF SUBJECT MATTER

IPC - C08G 61/02; C08G 61/12; C09K 11/06 (2021.01)

CPC - C08G 61/02; C08G 61/122; C09K 11/06

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.
A	US 2005/0158523 A1 (Gupta et al.) 21 July 2005 (21.07.2005) Abstract; para [0014], para [0030], Fig 2; para [0025].	1-22
A	US 2018/0104664 A1 (Twist Bioscience Corporation) 19 April 2018 (19.04.2018) Abstract; Figure 5, 7A, para [00139].	1-22
A	US 2020/0171484 A1 (Quantum Si Incorporated) 4 June 2020 (04.06.2020) Abstract; para [0015], para [0034], figure 3B, 4	1-22
A	US 2019/0240636 A1 (Twist Bioscience Corporation) 8 August 2019 (08.08.2019) Abstract; para [0003]-[0007], Figures 3	1-22
A	WO 2020/139871 A1 (Twist Bioscience Corporation) 2 July 2020 (02.07.2020) Abstract; para [00100], para [00172], Figure 2	1-22
T	WO 2021/167807 A1 (Polymer Forge Inc) 26 August 2021 (26.08.2021) Abstract; pg 11- pg 29	1-22

☐ 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 21/40567

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 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.:
1-22

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.

-----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 1-22 is directed towards a device for polymer synthesis, comprising: a solid support, wherein the solid support comprises a plurality of wells, wherein each of the wells comprises: a) a synthesis surface located in a bottom region of each of the wells; b) a light-emitting layer in addressable communication with the synthesis surface and situated below the synthesis surface; and c) a CMOS driver located in addressable communication with the light-emitting layer.

Group II: Claim 23-42 is directed towards a method for synthesizing a polymer, comprising: a) providing a solid support comprising a surface; b) depositing at least one nucleoside on the surface, wherein the at least one nucleoside couples to a polynucleotide attached to the surface, wherein the coupling comprises a light directed deprotection step by a light-emitting layer, and wherein the light-emitting layer is located beneath the surface; and c) repeating step b) to synthesize a plurality of polynucleotides on the surface, wherein polynucleotides having different sequences on the surface are present at a density of at least 100×10^6 polynucleotides per cm^2 .

The inventions listed as Groups I-II 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 a device for polymer synthesis, comprising a plurality of wells, and a CMOS driver located in addressable communication with the light-emitting layer, not required by groups II

Group II requires a method for synthesizing a polymer, comprising) depositing at least one nucleoside on the surface, wherein the at least one nucleoside couples to a polynucleotide attached to the surface, wherein the coupling comprises a light directed deprotection step by a light-emitting layer, repeating step b) to synthesize a plurality of polynucleotides on the surface, wherein polynucleotides having different sequences on the surface are present at a density of at least 100×10^6 polynucleotides per cm^2 , not required by groups I

Shared Technical Features:

Groups I-II share the common feature of a polymer synthesis comprising a solid support and a light-emitting layer in addressable communication with the synthesis surface. However, these shared technical features do not represent a contribution over prior art, because the shared technical feature is anticipated by US 2015/0065393 A1 to Gen9 Inc(hereinafter Gen9). Gen9 discloses a polymer synthesis (abstract, synthesize polynucleotides) comprising a solid support (Fig 1 shows growing polynucleosides on a surface) and a light-emitting layer in addressable communication with the synthesis surface (para [0058], synthesizing oligonucleotides include light directed methods).

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-II lack unity under PCT Rule 13.

Note: Claim 42 is an improperly dependent claim. It is written as depending on claim 16, which is a device claim. For the purposes of this opinion, claim 42 is assumed to be depending from claim 39.