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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

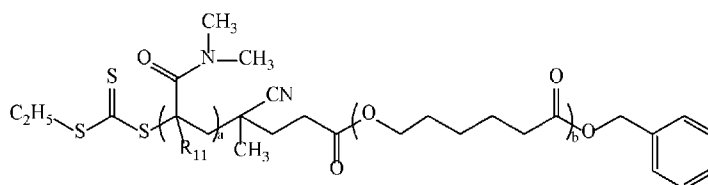
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(88) Date of publication of the international search report:

17 April 2025 (17.04.2025)

(54) Title: BLOCK COPOLYMERS WITH POLYESTER MOIETIES AND APPLICATIONS THEREOF

(57) Abstract: The invention provides block copolymers comprising polyester linkages. These copolymers are obtained by the reaction of polyester forming precursors, RAFT agents, and radically polymerizable monomers. The invention further provides compositions comprising the block copolymers and applications thereof in various industrial areas. The invention furthermore provides a method for reducing the particle size of an active ingredient by obtaining a composition that comprises colloidal particles of the block copolymers and the active ingredient and subjecting the composition to a suitable size reduction operation. Each a, b, and R₁₁ is described herein.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/33044

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. C08G 18/48, C08G 18/42, C08G 18/46 (2024.01)

ADD. C08J 3/12 (2024.01)

CPC - INV. C08G 18/48, C08G 18/42, C08G 18/4676

ADD. C08J 3/126

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 10,207,919 B2 (Rhodia Operations), 19 February 2019 (19.02.2019), entire document, especially col 2, ln 16-39; col 5, ln 27-28; col 8, ln 1-35	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40
A	"Pubchem CID 135005649", Create date: 30 November 2018 (30.11.2018), entire document, especially page 2, compound listed	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40
A	US 10,660,970 B2 (Genevant Sciences GMBH), 26 May 2020 (26.05.2020), entire document, especially col 2, ln 62-67; col 3, ln 1-20; col 9, ln 1-13; col 13, first two compounds listed Figure 12A	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40
A	US 2022/0025088 A1 (Solvay Specialty Polymers Italy S.P.A.), 27 January 2022 (27.01.2022), entire document, especially para[0018]-[0027]	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40
A	Lai et al., "Functional Polymers from Novel Carboxyl-Terminated Trithiocarbonates as Highly Efficient RAFT Agents", 02 August 2002 (02.08.2002), Macromolecules, 35, 18, Pages 6754-6756, entire document, especially Schemes 1-2	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40
A, P	US 2024/0117103 A1 (Seoul National University R&DB Foundation), 11 April 2024 (11.04.2024), entire document, especially para[0007]-[0015]	1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40

☐ 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

01 August 2024

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/33044

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.:
1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40

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.

Box III: lack of unity

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 1-40 are directed to a polymer having the structure as seen as in instant Claim 1. Claim 1 will be searched to the extent that it encompasses the first species of claim 1, represented by a polymer having the structure wherein R4 is a C1 unfunctionalized hydrocarbyl moiety; R1 is a C1 unfunctionalized hydrocarbyl moiety; each R2 is independently H; each R3 is independently a C1 unfunctionalized hydrocarbyl moiety; Q1 is a C1 unfunctionalized hydrocarbylene moiety; Q2 is a C3 unfunctionalized alkylene; each a and e are independently about 5. It is believed that claims 1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, and 35-40 read on this first named invention, and thus these claims will be searched without fee. This first named invention has been selected based on the guidance set forth in section 10.54 of the PCT International Search and Preliminary Examination Guidelines. Applicant is invited to elect additional compounds of claim 1, wherein each additional compound elected will require one additional invention fee. Applicants must specify the claims that encompass any additionally elected compound. Applicants must further indicate, if applicable, the claims which encompass the first named invention, if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the '+' group(s) will result in only the first claimed invention to be searched. Additionally, an exemplary election wherein different actual variables are selected is suggested. An exemplary election would be a polymer having the structure wherein R4 is a C1 unfunctionalized hydrocarbyl moiety; R1 is a C2 unfunctionalized hydrocarbyl moiety; each R2 is independently H; each R3 is independently a C1 unfunctionalized hydrocarbyl moiety; Q1 is a C1 unfunctionalized hydrocarbylene moiety; Q2 is a C3 unfunctionalized alkylene; each a and e are independently about 5 (i.e., claims 1-2, 4, 12, 16, 18-19, 23-24, 26, 30, 32, 35-40).

Group II: Claims 41-47 are directed to a method for reducing particle size of at least one active ingredient comprising (a) contacting to form a mixture, said active ingredient in a solid form and a colloidal composition comprising a polymer having the structure as listed in instant claim 41; and (b) subjecting said mixture to at least one particle size reduction operation.

The groups of inventions listed above 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:

Each invention in Group I+ includes the technical feature of a unique polymer having the structure as seen in instant claim 1, which is not required by any other invention of Group I+.

Group II includes the technical feature of a method for reducing particle size of at least one active ingredient comprising (a) contacting to form a mixture, said active ingredient in a solid form and a colloidal composition comprising a polymer having the structure as listed in instant claim 41; and (b) subjecting said mixture to at least one particle size reduction operation, which is not required by Group I+.

Common Technical Features:

The inventions of Groups I+ and II share the technical feature of a polymer having the structure as seen in instant claim 1.

These shared technical features, however, do not provide a contribution over the prior art as being obvious over US 10,207,919 B2 to Rhodia Operations (hereinafter 'Rhodia') in view of a document entitled "Pubchem CID 135005649" (hereinafter 'Pubchem-649'). Rhodia teaches a compound analogous to a polymer having the structure as seen in instant claim 1 wherein R4 is a C1 unfunctionalized hydrocarbyl moiety; each R2 is independently H; each R3 is independently a C1 unfunctionalized hydrocarbyl moiety; each Q1 is independently a C1 unfunctionalized hydrocarbylene moiety; each Q2 is a C3 unfunctionalized alkylene moiety; each a and e independently is about 5 (col 2, ln 16-39, 'In a third aspect, the present disclosure relates to a dendrimer represented by the structure...wherein each occurrence of L1 is C16 alkylene...each occurrence of R2 is independently C16 alkyl...wherein L1 and R2 are each interrupted by one or more divalent moieties.'; see second structure listed; col 5, ln 27-28, 'As used herein, the term "alkylene" means a divalent branched saturated hydrocarbon radical...'; the C16 alkylene is branched wherein the alkylene has the structure -CH(CH3)-CH2-CH(CH3)-CH2-CH(CH3)-CH2-CH(CH3)-CH2-CH(CH3)-CH2-CH2-; col 8, ln 1-35, 'The interruption may be in a carbon-carbon bond, a carbon-hydrogen bond, a carbon-heteroatom bond, a hydrogen-heteroatom bond, or heteroatom-heteroatom bond. The interruption may be at any position in the substituent modified, even at the point of attachment to another structure. The one or more divalent moieties may be selected from the group consisting of the following'; see the second structure in the fifth row; there are a total of six interruptions, each consisting of the moiety -C(O)O-, wherein the first interruption is at the end of the C16 alkylene and the remaining five interruptions are distributed within the C16 alkyl represented by R2 wherein the structure is as follows: -(CH3)3-C(O)O-(CH3)3-C(O)O-(CH3)3-C(O)O-(CH3)3-C(O)O-(CH3)3-C(O)O-CH3 but does not teach wherein the polymer ends with R1-trithiocarbonatyl wherein R1 is a C1-C11 functionalized or unfunctionalized hydrocarbyl moiety. However, Pubchem-649 does teach a compound analogous to a polymer as seen in instant claim 1 wherein the polymer ends with R1-trithiocarbonatyl wherein R1 is a C4 unfunctionalized hydrocarbyl moiety (see page 2, compound listed). Therefore, based on the structural similarities between the two compounds, it would have been obvious to a person of ordinary skill in the art to combine these references and replace the terminal end of the polymer (i.e., the -S- moiety) of Rhodia's compound with a C4alkyl-trithiocarbonatyl substitution as taught by Pubchem-649 in order to isolate all possible derivatives of Rhodia's compounds by routine experimentation.

Accordingly, the inventions listed as Groups I+ and II above lack unity of invention under PCT Rule 13 because they do not share a same or corresponding special technical feature providing contribution over prior art.