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(71) Applicant: MNEMOSCIENCE GMBH [DE/DE]; Technologie Zentrum, C–203 Europa Platz, D–52068 Aachen (DE).

(71)(72) Applicant and Inventor: LANGER, Robert, S. [US/US]; 77 Lombard Street, Newton, MA 02158 (US).

(72) Inventor: LENDLEIN, Andreas; Bergstrasse 35–37, D–52062 Aachen (DE).

(74) Agent: PABST, Patrea, L.; Arnall Golden & Gregory, LLP, 2800 One Atlantic Center, 1201 West Peachtree Street, Atlanta, GA 30309–3450 (US).

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4 November 1999 (04.11.99)

(54) Title: SHAPE MEMORY POLYMERS

(57) Abstract

Shape memory polymer compositions, articles of manufacture thereof, and methods of preparation and use thereof are described. The shape memory polymer compositions can hold more than one shape in memory. Suitable compositions include at least one hard segment and at least one soft segment. The T_{trans} of the hard segment is preferably between –30 and 270 °C. At least one of the hard or soft segments can contain a cross–linkable group, and the segments can be linked by formation of an interpenetrating network or a semi–interpenetrating network, or by physical interactions of the blocks. Objects can be formed into a given shape at a temperature above the T_{trans} of the hard segment, and cooled to a temperature below the T_{trans} of the soft segment. If the object is subsequently formed into a second shape, the object can return to its original shape by heating the object above the T_{trans} of the soft segment and below the T_{trans} of the hard segment. The compositions can also include two soft segments which are linked via functional groups which are cleaved in response to application of light, electric field, magnetic field or ultrasound. The cleavage of these groups causes the object to return to its original shape.

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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 99/03923

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C08L101/00 B29C61/00

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)
IPC 6 C08L C08G B29C

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 422 693 A (THORATEC LAB CORP) 17 April 1991 (1991-04-17) claims 1,4,5 page 3, line 38 - page 4, line 6 ---	1,31
X	LI YONG ET AL: "Shape Memory Gels Made by the Modulated Gel Technology" JOURNAL OF APPLIED POLYMER SCIENCE, vol. 63, no. 9, 28 February 1997 (1997-02-28), pages 1173-1178, XP002111074 New York, USA the whole document --- -/--	1,9

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 August 1999	22. 09. 1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Niaounakis, M

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter ›nal Application No
PCT/US 99/03923

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HU ZHIBING ET AL: "Sythesis and Application of Modulated Polymer Gels" SCIENCE, vol. 269, no. 5223, 28 July 1995 (1995-07-28), pages 525-527, XP002111075 Washington, USA the whole document	1,9
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 227 (C-0839), 10 June 1991 (1991-06-10) & JP 03 068611 A (DAIKIN IND LTD), 25 March 1991 (1991-03-25) abstract	1
A	EP 0 385 443 A (DAIKIN IND LTD) 5 September 1990 (1990-09-05) claim 1	1
A	EP 0 374 961 A (ASAHI CHEMICAL IND) 27 June 1990 (1990-06-27) claims 1,10	1

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/03923

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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.: 1-40
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:

see FURTHER INFORMATION sheet PCT/ISA/210

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 II Observations where unity of invention is lacking (Continuation of item 2 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 an additional fee, this Authority did not invite payment of any additional fee.

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.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Present claims 1-40 relate to compositions/methods defined by reference to a desirable characteristic or property, namely, to shape memory polymer compositions having at least two shapes in memory and methods of preparation thereof.

The claims cover all compositions/methods having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT for only a very limited number of such compositions/methods. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the compositions/method by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims relating to the compositions/methods as mentioned in examples 1, 2.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

'national Application No
PCT/US 99/03923

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