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(54) Title: PROCESS OF PREPARING FUNCTIONALIZED POLYMERS VIA ENZYMATIC CATALYSIS

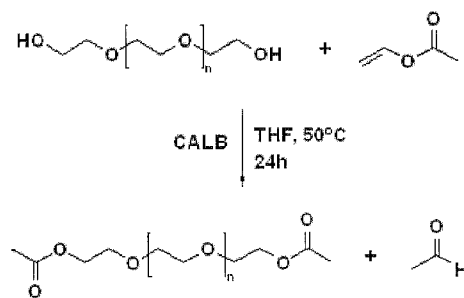


FIG. 1

(57) Abstract: Abstract The invention relates to functionalized, telechelic polymers synthesized by enzymatic catalysis and methacrylates, and the functionalization of polymers via Michael addition with a lipase catalyst, and the crosslinking of mono- or difunctional (telechelic) polymers made by enzymatic catalysis, such as by using multifunctional coupling agents and enzyme catalysts. Quantitative transesterification of vinyl methacrylate with poly(ethylene glycol), poly(isobutylene) and poly(dimethylsiloxane) was achieved using *Candida antarctica* lipase B. In addition, methacrylate-functionalized poly(ethylene glycol) monomethyl ether has been successfully coupled to aminoethoxy poly(ethylene glycol) monomethyl ether via Michael addition using *Candida antarctica* lipase B. Amine-functionalized poly(ethylene glycol)s have also been used for the preparation of poly(ethylene glycol)-based dendrimers and gels through Michael addition of the polymer onto triacryloyl hexahydro-triazine using the same enzyme. ¹H and ¹³C NMR spectroscopy verified the structure of the functionalized polymers.



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A. CLASSIFICATION OF SUBJECT MATTER*C08G 63/91(2006.01)i, C08G 63/82(2006.01)i, C09D 167/00(2006.01)i, C09D 175/16(2006.01)i*

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 08: C08G 63/91, 63/82, C09D 167/00, 175/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility Models and applications for Utility Models since 1975

Japanese Utility Models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKipass (KIPO internal) "(trans-esterification) & (enzyme or lipase)"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/0242831 A1 (AMSTRONG WORLD INDUSTRIES, INC.) December 02, 2004 see the whole document.	1 - 42
A	US 6,677,427 B1 (Hercules Incorporated) January 13, 2004 see the whole document.	1 - 42
A	US 5,449,743 A (Shin-Etsu Chemicals Co., Ltd.) September 12, 1995 see the whole document.	1 - 42
A	WO 99/46397 A1 (HENDEL KOMMANDITGESELLSCHAFT AUF AKTIEN) September 16, 1999 see the whole document.	1 - 42

 Further documents are listed in the continuation of Box C. See patent family annex.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004-242831 A1	02.12.2004	CN 1572851 A	02.02.2005
		CN 1572851	02.02.2005
		EP 1482001 A1	01.12.2004
		JP 2004-357707	24.12.2004
		JP 2004-357707 A	24.12.2004
		KR 10-2004-0103420	08.12.2004
US 6677427	13.01.2004	AU 2001-268385 B2	24.12.2001
		AU 2001-68385 A1	24.12.2001
		AU 6838501 A	24.12.2001
		CA 2408922 A1	20.12.2001
		CA 2408922 C	20.12.2001
		CN 1436244 A	13.08.2003
		EP 1290211 A2	12.03.2003
		JP 2004-503665	05.02.2004
		JP 2004-503665 T	05.02.2004
		KR 10-2003-0036219	09.05.2003
		PA 02012139 A	25.04.2003
		PL 358406 A1	09.08.2004
		US 6677427 B1	13.01.2004
		WO 01-96588 A2	20.12.2001
WO 01-96588 A3	21.03.2002		
ZA 200300349 A	13.04.2004		
US 5449743 A	12.09.1995	EP 0610718 A2	17.08.1994
		EP 0610718 A3	19.07.1995
		JP 07-097453	11.04.1995
		JP 7097453 A	11.04.1995
WO 99-46397 A1	16.09.1999	US 5962624	05.10.1999
		US 5962624 A	05.10.1999