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[54] **PHOTOPOLYMERIZABLE BIODEGRADABLE HYDROGELS AS TISSUE CONTACTING MATERIALS AND CONTROLLED-RELEASE CARRIERS**

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Related U.S. Application Data

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[52] **U.S. Cl.** **424/426**; 128/898; 424/489; 525/54.1; 525/54.2; 525/408; 525/413; 525/415; 514/772.1; 514/772.3; 514/773; 514/777; 528/354; 528/361

[58] **Field of Search** 424/426, 489; 514/772.1, 772.3, 773, 777; 525/54.1, 54.2, 408, 413, 415; 528/354, 361; 128/898; 427/399; 523/105, 112, 113, 114, 115

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,640,741	2/1972	Etes	106/170
3,925,895	12/1975	Kliment et al.	32/15
3,960,150	6/1976	Hussain et al.	128/260
3,981,303	9/1976	Higuchi et al.	128/260
3,986,510	10/1976	Higuchi et al.	128/260
3,993,071	11/1976	Higuchi et al.	128/260

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

D. 195304	9/1986	European Pat. Off.	C12N 9/96
0195304	9/1986	European Pat. Off.	C12N 9/96
0354855	2/1990	European Pat. Off.	A61K 009/12
0399441	11/1990	European Pat. Off.	C09D 4/00
0466648	1/1992	European Pat. Off.	D06P 1/38
2232839	1/1973	Germany .	
3716544	10/1987	Germany	C11D 3/37
277454	4/1990	Germany	C03C 17/28

(List continued on next page.)

OTHER PUBLICATIONS

Abraham, K. M., et al., "Dimensionally Stable MEEP–Based Polymer Electrolytes and Solid–State Lithium Batteries," Chem. Mater. 3:339–348 (1991).

Abuchowski, et al., "Alteration of Immunological Properties of Bovine Serum Albumin by Covalent Attachment of Polyethylene Glycol," J. Biol. Chem., 252(11):3578–3581 (1977).

(List continued on next page.)

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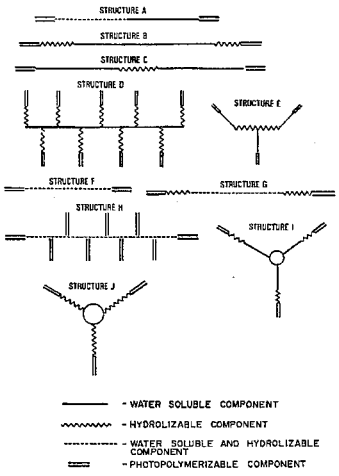
[57] **ABSTRACT**

Hydrogels of polymerized and crosslinked macromers comprising hydrophilic oligomers having biodegradable monomeric or oligomeric extensions, which biodegradable extensions are terminated on free ends with end cap monomers or oligomers capable of polymerization and cross linking are described. The hydrophilic core itself may be degradable, thus combining the core and extension functions. Macromers are polymerized using free radical initiators under the influence of long wavelength ultraviolet light, visible light excitation or thermal energy. Biodegradation occurs at the linkages within the extension oligomers and results in fragments which are non-toxic and easily removed from the body. Preferred applications for the hydrogels include prevention of adhesion formation after surgical procedures, controlled release of drugs and other bioactive species, temporary protection or separation of tissue surfaces, adhering of sealing tissues together, and preventing the attachment of cells to tissue surfaces.

43 Claims, 9 Drawing Sheets