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(54) **BLOCK COPOLYMER PROCESSING FOR MESOSTRUCTURED INORGANIC OXIDE MATERIALS**

(75) Inventors: **Galen D. Stucky**, Goleta, CA (US); **Bradley F. Chmelka**, Goleta, CA (US); **Dongyuan Zhao**, Shanghai (CN); **Nick Melosh**, Tucson, AZ (US); **Qisheng Huo**, Williamsville, NY (US); **Jianglin Feng**, Charlottesville, VA (US); **Peidong Yang**, Santa Barbara, CA (US); **David Pine**, Santa Barbara, CA (US); **David Margolese**, Montecito, CA (US); **Wayne Lukens, Jr.**, Summerland, CA (US); **Glenn H. Fredrickson**, Santa Barbara, CA (US); **Patrick Schmidt-Winkel**, Bad Gams (AT)

(73) Assignee: **The Regents of the University of California**, Oakland, CA (US)

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(58) **Field of Classification Search** 117/924; 210/660

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,770,275	A *	6/1998	Raman et al.	427/535
5,871,646	A *	2/1999	Jones et al.	210/500.21
6,503,382	B1 *	1/2003	Bartlett et al.	205/67
6,592,764	B1 *	7/2003	Stucky et al.	210/660
6,592,991	B1 *	7/2003	Wiesner et al.	428/404

FOREIGN PATENT DOCUMENTS

GB	2267486	A *	12/1993
GB	9713580	*	3/1997

OTHER PUBLICATIONS

Family List for US Patent 6,503,382 printed Feb. 9, 2006 from European Patent Office website at http://v3.espacenet.com/family?DB=EPODOC&IDX=US6503382&F=8&OREQ=0&textdoc=TRUE.*

* cited by examiner

Primary Examiner—Robert E. L. Sellers
Assistant Examiner—Timothy J. Kugel
(74) *Attorney, Agent, or Firm*—Berliner & Associates

(57) **ABSTRACT**

Mesoscopically ordered, hydrothermally stable metal oxide-block copolymer composite or mesoporous materials are described herein that are formed by using amphiphilic block polymers which act as structure directing agents for the metal oxide in a self-assembling system.

4 Claims, 62 Drawing Sheets