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(54) **APPARATUS FOR CAPILLARY ELECTROPHORESIS AND ASSOCIATED METHOD**

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(58) **Field of Search** 204/601-615, 204/616; 428/34.4, 36.9, 34.7, 36.8

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,181,999	A	*	1/1993	Wiktorowicz	.....	204/180.1
5,391,274	A	*	2/1995	Shieh	.....	204/180.1
5,569,364	A	*	10/1996	Hooper et al.	.....	204/455
5,716,709	A		2/1998	Ferguson		
6,056,860	A	*	5/2000	Amigo et al.	.....	204/454
6,074,541	A	*	6/2000	Srinivasan	.....	204/451
6,117,326	A	*	9/2000	Schure et al.	.....	210/635

FOREIGN PATENT DOCUMENTS

EP 0284394 * 9/1988

OTHER PUBLICATIONS

Ziad El Rassi and Wassim Nashabeh, Capillary Zone Electrophoresis of Biopolymers with Hydrophilic Fused-Silica Capillaries. *Capillary Electrophoresis Technology*, Guzman, N. A. Eds.; Marcel Dekker; New York, 1993 (Chapter 11). Tarek Farhat, Ghada Yassin, Stephan T. Dubas, and Joseph B. Schlenoff, Water and Ion Pairing in Polyelectrolyte Multilayers 1999 *Langmuir*; vol. 15, No. 20. (pp. 6621-6623).

Mathias Lösche, Johannes Schmitt, Gero Decher, Wim G. Bouwman, and Kristian Kjaer, Detailed Structure of Molecularly Thin Polyelectrolyte Multilayer Films on Solid Substrates as Revealed by Neutron Reflectometry 1998, *Macromolecules*, 31, pp. 8893.

(List continued on next page.)

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(57) **ABSTRACT**

An apparatus and method for capillary zone electrophoresis includes a polyelectrolyte multilayer positioned in a capillary tube for analytical separations of macromolecules. The capillary comprises a passage defined by passage walls comprising fused silica. The polyelectrolyte multilayer is positioned within the passage adjacent the walls, and comprises an organic polyelectrolyte. The passage may further comprise nonporous silica particles coated with a multilayer including a plurality of polyelectrolyte layers. An apparatus includes a power supply having a positive electrode and a negative electrode for generating an electric field therebetween. The apparatus includes a capillary having a passage formed by passage walls and comprising therein a polyelectrolyte multilayer positioned substantially within the passage. The passage has a first end electrically connected to the positive electrode and a second end electrically connected to the negative electrode to thereby generate an electric field through the passage. The apparatus also includes a sensor positioned adjacent the passage for sensing macromolecules.

13 Claims, 13 Drawing Sheets

