US007828948B1

(12) **United States Patent**
Hatch et al.

(10) **Patent No.: US 7,828,948 B1**
(45) **Date of Patent: Nov. 9, 2010**

(54) **PRECONCENTRATION AND SEPARATION OF ANALYTES IN MICROCHANNELS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 935 days.

(21) Appl. No.: **11/536,753**

(22) Filed: **Sep. 29, 2006**

Related U.S. Application Data

(60) Provisional application No. 60/725,015, filed on Oct. 6, 2005.

(51) **Int. Cl.**
B01D 57/02 (2006.01)
B01D 61/58 (2006.01)
B01D 63/00 (2006.01)

(52) **U.S. Cl.** **204/455**; 204/605

(58) **Field of Classification Search** 204/451, 204/455, 601, 605

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,007,690	A *	12/1999	Nelson et al.	204/601
6,235,471	B1 *	5/2001	Knapp et al.	435/6
6,319,469	B1 *	11/2001	Mian et al.	422/64
2001/0044108	A1	11/2001	Shih	
2003/0116437	A1 *	6/2003	Burns et al.	204/453
2004/0084370	A1	5/2004	Singh	
2004/0112751	A1	6/2004	Han	

OTHER PUBLICATIONS

F. Helfferich; "Ligand Exchange. II. Separation of Ligands Having Different Coordinative Valences", Journal of the American Chemical Society, 1962. vol. 84, pp. 3242-3245.

Martin M. Chui; Ronald J. Phillips; Michael J. McCarthy; "Measurement of the Porous Microstructure of Hydrogels by Nuclear Magnetic Resonance", Journal of Colloid and Interface Science, 1995, vol. 174, pp. 336-344.

Daniel Figeys: Normal J. Dovichi; "Multiple separations of DNA sequencing fragments with a non-cross-linked polyacrylamide-filled capillary: capillary electrophoresis at 300 V/cm". Journal of Chromatography A, 1995, vol. 717, pp, 113-116.

A. S. Rathore: Cs. Horvath; "Axial Nonuniformities and Flow in Columns for Capillary Electrochromalography", Analytical Chemistry, 1998, vol. 70, pp. 3069-3077.

Julia Khandurina: Stephen C. Jacobson; Larry C. Waters; Robert S. Foote; J. Michael Ramsey; "Microfabricated Porous Membrane Structure for Sample Concentration and Electrophoretic Analysis", Analytical Chemistry. 1999, vol. 71, pp. 1815-1819.

(Continued)

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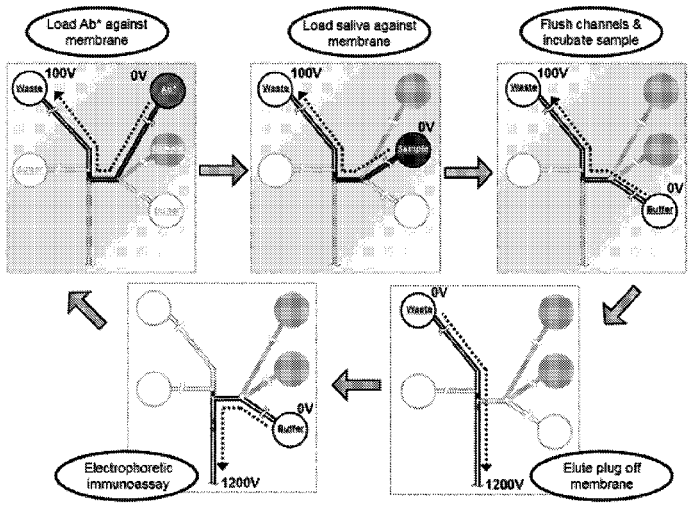
(57) **ABSTRACT**

Disclosed herein are methods and devices for preconcentrating and separating analytes such as proteins and polynucleotides in microchannels. As disclosed, at least one size-exclusion polymeric element is adjacent to processing area or an assay area in a microchannel which may be porous polymeric element. The size-exclusion polymeric element may be used to manipulate, e.g. concentrate, analytes in a sample prior to assaying in the assay area.

21 Claims, 26 Drawing Sheets