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(54) **MICROFLUIDIC PLATFORM OF ARRAYED SWITCHABLE SPIN-VALVE ELEMENTS FOR HIGH-THROUGHPUT SORTING AND MANIPULATION OF MAGNETIC PARTICLES AND BIOMOLECULES**

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(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,843,316 A	6/1989	Hesterman
5,434,826 A	7/1995	Ravipati et al.
5,478,527 A	12/1995	Gustafson et al.
5,793,279 A	8/1998	Nepela
6,175,476 B1	1/2001	Huai et al.
6,775,110 B1	8/2004	Hayashi et al.
2002/0024778 A1	2/2002	Xue et al.
2002/0081714 A1	6/2002	Jain et al.
2002/0086443 A1*	7/2002	Bamdad 436/526

(Continued)

OTHER PUBLICATIONS

Grollier et al., "Switching the magnetic configuration of a spin valve by current induced domain wall motion", Journal of Applied Physics, Oct. 15, 2002, vol. 92, pp. 4825-4827.*

(Continued)

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(57) **ABSTRACT**

Arrays of spin-valve elements that can be selectively activated to trap, hold, manipulate and release magnetically tagged biological and chemical particles, including molecules and polymers. The spin-valve elements that can be selectively activated and deactivated by applying a momentary applied magnetic field thereto. The spin valve element array can be used for selectively sorting and transporting magnetic particles one particle at a time within the array. As the magnetically tagged particles are held by the spin-valve elements, application of an auxiliary magnetic field can be used to apply tension or torsion to the held particles or to move, e.g. rotate, the trapped particles. The arrays of spin-valve elements can be used in a variety of applications including drug screening, nucleic acid sequencing, structural control and analysis of RNA/DNA and proteins, medical diagnosis, and magnetic particle susceptibility and size homogenization for other medical applications.

24 Claims, 8 Drawing Sheets

