A Novel Micro/Nano-Porous Electroosmotic Pump

Technology Description:
Researchers from Old Dominion University have developed a novel miniature Electroosmotic (EO) pump using thin membrane fabricated from porous silicon. Through Atomic layer deposition technology, nested coatings were deposited in the inner pores of the macroporous Si membrane, thus enabling precise control of the EO pump flow rate, through modulation of the surface zeta potential.

Competitive Advantages:
- Battery operated low D.C. voltage (<5V);
- Low power consumption (~10μW);
- 2-terminal EO pump achieving 50μl/m V cm², where ionic fluid is driven solely by electrical fields; advanced innovative 3-terminal EO pump design enables higher flow rates;
- Minimizes electrolysis, electrode oxidation, and Joule heating effects observed in micro-EO pumps;
- Avoids using of any mechanical components;
- Delivers both fixed and variable flow rate for specific delivery requirements;
- The porous silicon template is lithographically defined and scalable and easily amendable for high volume production in a fully integrated state-of-art clean room process.

Applications:
The miniaturized EO pump can be developed as stand alone pumping applications or part of an integrated microfluidic device for
- Drug delivery applications
- Biomedical research and point-of-care diagnostic applications
- Micro electronic cooling
- Chemical analysis and synthesis

Intellectual property:
- Patent pending (PCT application filed April 2010), App No: PCT/US10/32316

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Zohir Handy
Office of Technology Licensing
Old Dominion University
4111 Monarch Way
Norfolk, VA 23508, USA
Tel 757-683-5052 Fax 757-683-5902 email zhandy@odu.edu
Seeks partner for commercializing a —

A Novel Micro/Nano-Porous Electroosmotic Pump

Proof of concept: Transport of DI water through our nanoporous EO pump (Prototype constructed with aluminum oxide membrane, AAO membrane)

SEM top down displaying the Pt ALD coating inside the AAO nanopore

Inventors

Dr. Helmut Baumgart is professor and Virginia Microelectronics Consortium endowed Chair, Department of Electrical and Computer Engineering, Old Dominion University. He obtained his PhD. Degree from University of Stuttgart, Germany, while performing research at the Max-Planck Institute of Solid State Research in Stuttgart. Prior to joining ODU, he had held numerous R&D positions in leading microelectronics industry firms, including AT&T Bell Labs and IBM Microelectronics at the Advanced Semiconductor Technology Centers in New York. In his research field, he had authored and co-authored over 87 papers, and held 13 international patents.

Dr. Ali Beskok is the Batten Endowed Chair Professor of Computational Engineering, and Director of the Micro and Nanotechnology Institute at Old Dominion University. He obtained his MS and PhD. in Mechanical and Aerospace Engineering from Princeton University in 1996. He has been an author of 2 books, 7 book chapters 53 journal articles and 43 conference proceedings in his field. He holds 1 international patent.

Dr. Diefeng Gu received his Ph.D. degree in Materials Science from Arizona State University in 2006. He is currently a senior research scientist at Applied Research Center, Old Dominion University.

Dr. Seungkyung Park received his Ph.D. degree in Mechanical Engineering from Texas A&M University in 2008, under the direction of Dr. Beskok. He is currently working at Johns Hopkins school of Medicine as a postdoctoral fellow.

Dr. Tarek Abdel-Fattah is the Associate professor of Chemistry and director of the Applied Research Center at Christopher Newport University. He obtained his Ph.D. in inorganic chemistry and materials chemistry from North Eastern University. He has published over 20 papers, 2 patents and over 50 presentations in national and international meetings.