Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Sorting Category: 10.14.12 (E)

Patterned Periodic Nanofilter Array for Continuous-Flow Bimolecular Separation JIANPING FU, Department of Mechanical Engineering, MIT, JONGYOON HAN, Department of Electrical Engineering and Computer Science, Division of Biological Engineering, MIT — We present an experimental study on sieving process of small biomolecules (i.e., proteins and small DNAs) in one- and two-dimensional periodic arrays of nanofilter. The nanofilters served as artificial sieves with precise pore size characterization and showed exceptional size selectivity and separation efficiency from the periodicity of the environment. A kinetic model is developed to explain the electrophoretic drift of charged molecules across periodically modulated free energy landscapes. Further experimental evidence shows the crossover from Ogston-like sieving to entropic trapping mechanism depending on nanofilter thickness and on electric field strength. We also demonstrate continuous-flow biomolecule separation with a device containing of two-dimensional periodic nanofilter arrays. The interaction between migrating molecules and the two-dimensional physical landscapes cause molecules of different sizes to follow radically different paths leading to separation. Continuous-flow fractionations of small DNA molecules (50bp-766bp) as well as SDS-protein complexes (11kDa-200kDa) were achieved in about 5 minutes with a resolution of 10%. By virtue of its gel-free and continuous-flow operation, this device suggests himself a key component to an integrated biomolecule sample preparation and analysis microsystem.

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[X] Prefer Oral Session
[ ] Prefer Poster Session

Date submitted: 30 Nov 2005 Electronic form version 1.4