
Development of Monolithic Biomolecule Analysis Device

Personnel

J. Han

Sponsorship

NSF/SRC Engineering Research Center for Environmental Benign Semiconductor Manufacture

In the areas of biology and biotechnology, there are big demands for faster, cheaper and more accurate methods to extract, separate, and analyze various biomolecules (proteins and nucleic acids). Micro Total Analysis Systems (micro TAS) could provide solutions for large-scale bioanalysis projects, such as Human Genome Project. Even though a lot of chemical and biological analysis processes were implemented in a microchip environment, still there are important technological barriers to be overcome. Integration of various analysis components remains as a goal to achieve, mainly because of material incompatibility between molecular sieving materials and standard MEMS materials.

In this project, we are aiming toward completely monolithic bioanalysis systems, by developing biomolecule separation device using nanostructures as a molecular sieve. Unlike conventional gel or random porous materials, these nanofluidic systems can be precisely designed and fabricated, and generally much more robust. Eventually, this will enable much easier integration of microanalysis systems.

To achieve this goal, we plan to perform researches along the following two directions. (1) Nanofluidic biomolecule separation: Current microfluidic bioanalysis system mostly uses the same polymeric sieving materials as their conventional counterparts, which makes the integration difficult. In this area, we are trying to develop an artificial nanofluidic structures can be used as an alternative, monolithic sieving material for various biomolecules. Also new knowledge about biomolecule dynamics in nanostructures could be obtained from these experiments. (2) Manipulation of biomolecules in nanostructure : Nanofluidic structures can be used to manipulate biomolecules and/or bioparticles of interest, which might lead to a novel biomolecule detection / analysis devices. In this area, we will explore the possibility of using nano/microfluidic structures to affect the motion of fluid and/or biomolecules.