NANOSTRUCTURE INCORPORATION IN ANALYTICAL SYSTEMS

Harold Craighead
Cornell University, Ithaca NY USA

Nanofabrication technologies have been explored for use in a range of analytical systems. Lithographic approaches allow the integration of engineering structures of controlled geometry with microfluidics, optics and electronics. Non-lithographic approaches or self-assembly can create nanoscale features but usually at the expense of full geometrical control of the structures. An intermediate approach imparts some degree of order on self-assembled nanostructures. In general the nanostructure enable access to physical phenomena, extant at the reduced dimension, that may be harnessed for new analytical or materials formation approaches.

Our group has explored a number of methods for creating small structures and is investigating phenomena, related to these nano-scale structures, that may be employed in conjunction with microfluidic systems. The simplest structures consist of reduced dimensional fluid channels such as tubes or slits with dimensions smaller than a physical length scale, that can be formed in a way to utilize this dimension-related physical regime. Porous media are examples of a class of materials with nano-scale structures that may be incorporated integrated with larger scale fluid handling. Nanofibers, membranes, nanotubes and nanopores are structures that can be ordered to some degree for their incorporation into simple systems.

We have investigated approaches for incorporating nano-scale tubes, fibers, apertures, and other structures into fluidic systems, and linking these to electrical, optical or mechanical signal transduction. These approaches can be used to investigate molecular manipulation and detection. They also allow study of chemical and biochemical reactions at the individual molecule level. These approaches are finding use in areas such as genetic analysis, ultra-rapid DNA sequencing and analysis of individual living cells.