CENTER FOR NANOSCALE SCIENCE AND TECHNOLOGY

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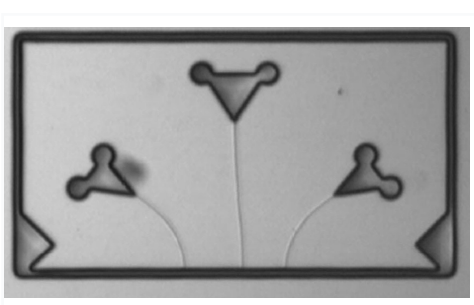
Professor Saif received his BS and MS degrees in Civil Engineering from Bangladesh University of Engineering and Technology and Washington State University respectively in 1984 and 1986. He obtained his Ph.D degree in Theoretical and Applied Mechanics from Cornell University in 1993. He worked as a Post Doctoral Associate in Electrical Engineering and the National Nanofabrication Facility at Cornell University during 1993-97. He joined the Department of Mechanical and Industrial Engineering at the University of Illinois at Urbana-Champaign during 1997. His current research projects include actuation of MEMS by light beams, mechanical behavior of nanoscale materials, interaction between small thin plates forming menisci with a fluid, and mechanical response of single living cells due to local deformations.

SEMINAR SERIES

Guided self assembly of nano channels and wires

Wednesday, October 1, 2003
4:00 p.m.
B02 Coordinated Science Laboratory
Reception to Follow



A major challenge of nanotechnology is the synthesis of nano components, such as nano wires. There are two general approaches: in the top down approach, where fine lithography is used, structures are produced according to a prescribed pattern, but fabrication is time consuming and expensive In the bottom-up approach, a chemical reaction is initiated when atoms or molecules combine or self assemble to form nano structures such as nano tubes or nano wires of Si3N4, but the structures may be randomly arranged. The challenge, thus, is to come up with a technique that harnesses the attractive self assembly approach but allows control on the final pattern. We present such a method of fabricating nano wires and channels. Here, oxide is deposited on Silicon substrate in the form of SiO2/3OH, which when annealed, forms SiO2 with residual tension. The tensile stress can be high enough to crack the oxide with a random pattern, like mud cracks. The crack is through the thickness of the oxide. It is around 50nm wide, several micro meters tall depending on the thickness of the oxide (2-6μm), and may be milli meters long. The cracks are thus deep nano channels, although the depth can be controlled. The cracks can partially be filled by Ni using electroless deposition technique. The metal replicates the crack, forming a network of nano wires. They are 50-100nm in width, and can be 10s of μm long. The crack pattern can be controlled by guiding the self assembly process of crack growth, simply by prescribing the crack initiation and termination points using lithography. Corners serve as crack initiators by locally amplifying the tensile stress during annealing. Hence, a crack originates from the corner and propagates to meet a free surface perpendicularly. For example, the corner of a square generates a crack that meets a circle at 90 degrees. Thus, a nano channel can be placed between two patterned reservoirs, or a channel can be made to intersect another channel, and a complex network of reservoirs and channels can be obtained by guided self assembly. The nano channels and wires may be useful to develop nano/molecular fluidic networks for transport at a molecular scale.