Manufacturing at Micro and Nano Scale: The Merge of Science and Technology

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Abstract:

Current semiconductor manufacturing is at a cross-road: optical lithography will face tremendous difficulty as it approaches 50 nm critical dimension, and projection tools become prohibitively expensive. In addition, to match the continually shrinking critical dimensions and increasing complexity, 3D multilevel micro and nano device architecture becomes a necessity to increase the speed, reduce the power consumption and communication delay (save >60% compare to planar case). These challenges call for a fundamental change in the manufacturing paradigm. We envision two main critical challenges critical to expedite the technology revolution: (1) the ability to do lithography below 30 nm, and (2) the ability to fabricate 3D complex nanostructures. While it is realized that these are still far reaching goals at this point, in this talk, I will present our recent efforts toward them.

In the first part of this presentation, I'll discuss a new 3D manufacturing technology- Micro Stereo Lithography (μSL) that we developed, which is capable fabrication of highly complex 3D microstructures with smallest feature of 600 nm. Grey scale fabrication of micro-lens array and a micro optical scanner are demonstrated. This approach also provides a potential avenue to manufacture fully integrated micro optical bench on a chip for telecommunication applications. A theoretical model was established for simulation of 3D micro lithography. 3D photonic structures as well as fractal structures for tissue engineering will be introduced.

In 2nd part, I'll discuss our recent work on two new nanofabrication approaches: Linear and non linear Plasmonic Lithography. Surface plasmons promises an exciting engineering paradigm of optical frequency and x-ray wavelength. We demonstrated here the first Two Photon Near Field Lithography. By manipulating surface plasmonic band, we have shown the feasibility of a parallel plasmonic lithography. Finally, I will review current activities at SINAM (Center for Scalable and Integrated Nano-Manufacturing), a NSF funded Nano-scale Science and Engineering Center (NSEC).