Plasmonic Lithography for Nanomanufacturing

David B. Bogy and Lian Pan
Computer Mechanics Laboratory, Department of Mechanical Engineering
University of California, Berkeley, CA 94720
* *dbogy@berkeley.edu*

Presentation

Abstract: The semiconductor industry is beginning to be affected by the increasing cost of photolithography systems. Although the EUV immersion lithography system is expected to deliver 22 nm half pitch resolution, so far, there is still no cost effective solution for achieving smaller half pitch in mass production. In addition, the photo masks are becoming more and more complex and prohibitively expensive as the node size reduces. This trend opens up opportunities for high throughput mask-less approaches to address IC manufacturing. However, most mask-less lithography solutions are limited by their low throughput capabilities, making them unable to present a credible option for manufacturing purposes.

Here we report a new high-throughput mask-less nanolithography approach using plasmonic lens arrays flying over a disk at close proximity at 10 meter/second. The lens concentrates short wavelength surface plasmons into a sub-100 nm spot. However, the nano-scale focus only exists at the near field of the lens, typically 10-100 nm, making high-speed scanning of such arrays very difficult. We designed and fabricated a unique air-bearing slider that flies the arrays 10 nm above the surface of a spinning disk with speeds of 4-12 meter/second. We experimentally demonstrated the capability of patterning with 20 nm features. This low-cost nano-fabrication scheme has the potential of a few orders of magnitude higher throughput than current mask-less techniques, and it therefore promises a new route towards the next generation of nanomanufacturing.

Besides its application in nanolithography, this technique may also lead optical and magnetic data storage to achieve two orders of magnitude higher capacities in the future.