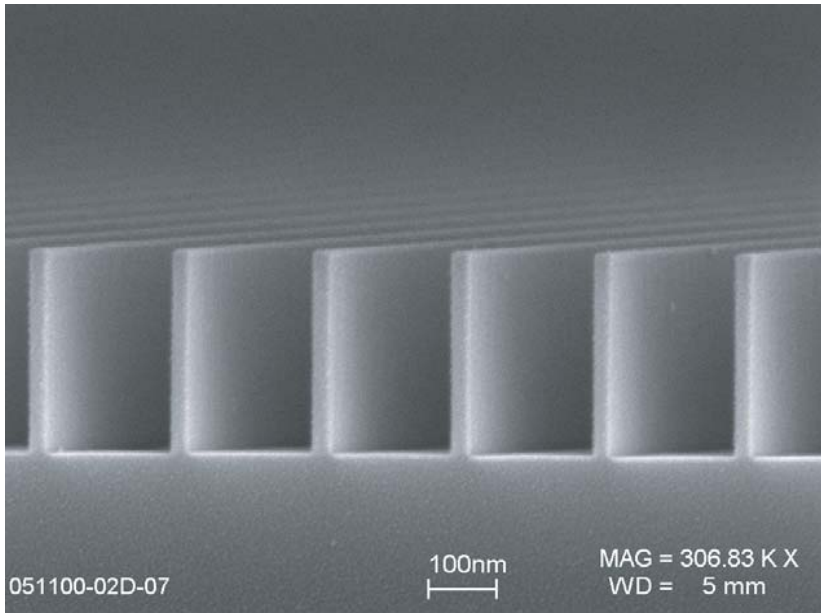
The Institute of OPTICS

Colloquium

UNIVERSITY of ROCHESTER

Subwavelength Optical Elements and Nanoimprint Technology for Miniaturization and Wafer-Scale Integration of Optical Systems



SOE quarter-waveplate in Si

Professor Stephen Y. Chou

Electrical Engineering, Princeton University

PhD MIT, 1986
Joseph C. Elgin Professor of Engineering
Head, NanoStructure Laboratory
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In this talk he will describe two platform technologies that are critical for miniaturization and integration of optical systems on a chip: Subwavelength optical elements and Nanoimprint technology.

Special time
2:45-3:45 pm, Monday
March 16, 2009
Sloan Auditorium, Goergen Building
Refreshments served

Subwavelength Optical Elements and Nanoimprint Technology for Miniaturization and Wafer-Scale Integration of Optical Systems

Stephen Y. Chou, Princeton University

Abstract: to miniaturize and integrate optical systems on a chip and fabricate them monolithically on wafer scale, two new platform technologies besides guided-wave integrated optics are crucial: (a) subwavelength optical elements (SOEs) --a new class of optical devices well suited for miniaturization and wafer-scale integration, and (b) nanoimprint technology--an enabling nanopatterning method. The talk will present a broad range of examples in SOEs and nanoimprint.

Subwavelength optical elements (SOEs) are optical devices with the feature size less than the wavelength of light, hence having no non-zero order diffraction. SOEs behave fundamentally different from bulk (i.e. ray) optics or diffraction optics [1-6]. First, SOEs can create new optical functions that are unavailable in bulk (free-space) or diffractive optics. Second, SOEs can perform an optical function of bulk (free-space) optics, but with a size over several orders of magnitude smaller. And third, SOEs perform different optical functions using different features geometries (shape and size) but the same materials; rather than different materials as in bulk optics. These properties of SOEs make them well suited for making optical systems on a chip.

To fabricate SOEs and harvest their potentials, a ultra-high-resolution large-area nanopatterning with high-throughput and low-cost is essential. Among all available nanopatterning methods, nanoimprint lithography (NIL), demonstrated large area 6 nm half-pitch, appears to be one of the most promising technology for SOE fabrication and many other disciplines.

Biography: Stephen Y. Chou, Joseph C. Elgin Professor of Engineering, the head of the NanoStructure Laboratory at Princeton University, received his PhD from MIT (1986). Dr. Chou's pioneering research and inventions have shaped new paths in the fields of nanofabrication, nanoscale electronics, optoelectronics, magnetics, biotechnology and materials, and have brought significant impacts to both academia and industry. As an entrepreneur, he founded Nanonex and NanoOpto, and is a co-Founder of BioNanoMatrix. Among other awards and honors, Dr. Chou is a member of National Academy of Engineering, IEEE Fellow, Packard Fellow, and an Inductee of New Jersey High Technology Hall of Fame, and received IEEE Brunetti Award. Dr. Chou's graduate work used X-ray lithography to scale MOSFETs to the 60 nm range (1982-86). Since 1985 he has demonstrated various ultra-small MOSFETs, quantum devices, and single electron transistors. In early 1990's, he began pioneering work in exploring sub-wavelength optical elements (SOEs) –a new class of optical devices suited for miniaturization and wafer-scale integration, and in bringing nanofabrication into magnetic data storage media. He invented quantized magnetic disks (now termed bit-patterned media) – a new paradigm in magnetic data storage. In 1994, he invented one of his best-known work, nanoimprint lithography (NIL), a revolutionary nanoscale patterning method that allows sub-10 nm patterning over large areas with high throughput and low cost. And he and his group are the first to apply NIL to a broad range of field such as electronics, optics, display, data storage, biotechnologies and materials. Since 2000, Dr. Chou and his group have been pioneering various innovative DNA sensors (nanochanels and nanogap detectors) by combining the cutting edge nanofabrication, nanoelectronics, and nanophotonics with biology. Dr. Chou is also a key inventor of lithographically induced self-assembly (LISA), laser-assisted direct imprint (LADI), and self-perfection by liquefaction (SPEL).