Serving the Industry for 50 Years

Home | Reference Library | Print Publications | Employment Ctr | Tech Focus | News & Analysis | Innovative Products | Calendar | Adve

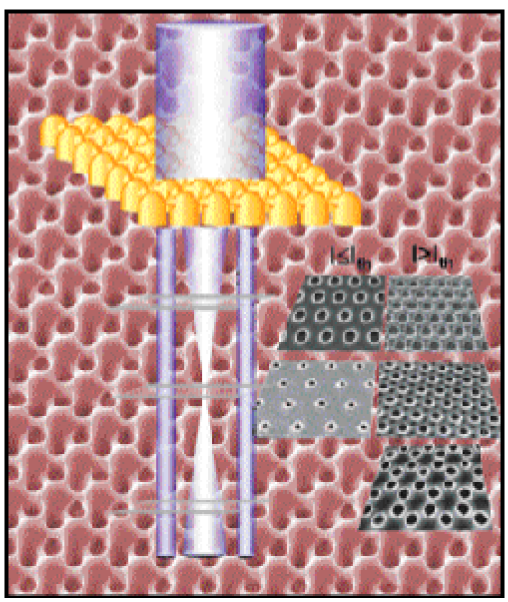
SPECTRA HOME
CURRENT ISSUE TABLE OF CONTENTS
TECHNOLOGY
BUSINESS
PRESSTIME BULLETIN
ARTICLE ABSTRACTS
ACCENT ON APPLICATIONS
PHOTONICS RESEARCH
PHOTONICS MINI-MAG
INNOVATIVE PRODUCTS
SUBSCRIBE
FOR ARTICLE SUBMISSIONS email editorial@ photonics group.com

Photonics TechnologyWorld
August 2005 Edition

Send News to photonics@laurin.com or submit online here

Two Imaging Elements Create One Multipattern Mask

Inspired by a species of thousand-eyed, ocean-dwelling brittle star, investigators at the University of Pennsylvania in Philadelphia, Massachusetts Institute of Technology in Cambridge and Bell Labs in Murray Hill, N.J., have demonstrated that two imaging elements -- a microlens and clear windows, or pores -- can be used to create a multipattern photomask. Utilizing an array of the two elements, the research group fabricated different structures by varying the array-to-substrate spacing, the intensity of the light source and the resist tone.



Inspired by the calcite microlens arrays on the dorsal arm plates of a brittle star, researchers have designed a multipattern photomask comprising microlenses and pores. The inset shows the patterns generated by the photomask with various tones of the resist and at exposure intensities greater or less than the resist threshold (I_{th}). Courtesy of Shu Yang.

The integrated microlens/pore array offers several advantages, said Shu Yang, an assistant professor of materials science and engineering at the University of Pennsylvania. "It can produce a variety of microstructures with different sizes and symmetry using a single mask, which is not possible by conventional lithography or other maskless lithography."

Such a capability would be attractive for the mass production of submicron periodic structures. The technique creates only repeating structures and cannot be used to produce arbitrary ones.

The researchers manufactured the microlens and pore mask using a technique called three-beam interference lithography. Regions that were highly exposed formed an array of lenses, which they could make from 1.5 to 4.5 µm in diameter and from about 0.2 to 1.0 µm in height. In the underexposed areas, pores formed. By adjusting the exposure time and intensity, they changed the pore size and density.

For their experiments, they spun resist on a glass substrate and covered it with a film of polydimethylsiloxane (PDMS), a transparent rubber. They placed the microlens/pore mask on top of this and used a 365-nm source to expose the resist under the PDMS. By varying the PDMS thickness, the intensity of the light source and the tone of the resist, they created different patterns, such as holes that ranged in size from 0.7 to 3 µm.

At intensities just below the resist threshold, the scientists created hexagonally packed holes that matched the microlens array. At intensities above the threshold and with the mask placed far beyond the lens focus, they created a honeycomb structure that could be of interest as a two-dimensional photonic crystal. As part of their investigation, they developed a model that predicted the effect of varying spacing, intensity and resist tone.

Work with the technique continues, and the scientists have plans to shrink the lens array and push the mask's lithographic limit to 100 nm or below. They also hope to combine the array with microfluidics and responsive lens materials to enable the adjustment of focus, transmission and other optical properties.

by Hank Hogan

Return to the previous page

Browse
Accent on Applications | Presstime Bulletin | Article Abstracts
BusinessWorld | Technology World | Photonics Research
Innovative Products | Spectra Contents

top of page

Photonics.com: Optical, Laser and Fiber Optics Resource
[Home | Reference Library | Print Publications | Employment Center | Tech Focus | News & Analys
[Innovative Products | Calendar | Advertising | About Laurin | Site Map]

Other Areas and Laurin Web Sites