

New method could lead to narrower chip patterns

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(PhysOrg.com) -- Researchers at MIT have found a novel method for etching extremely narrow lines on a microchip, using a material that can be switched from transparent to opaque, and vice versa, just by exposing it to certain wavelengths of light.

Such [materials](#) are not new, but the researchers found a novel way of harnessing that property to create a mask with exceptionally fine lines of transparency. This mask can then be used to create a correspondingly fine line on the underlying material.

Producing such fine lines is crucial to many new technologies, from microchip manufacturing that is constantly seeking ways to cram more components onto a single chip, to a whole host of emerging fields based on nano-scale patterns. But these technologies have faced fundamental limits because they tend to rely on light to produce these patterns, and most techniques cannot produce patterns much smaller than the wavelengths of light itself. This method is a way of overcoming that limit.

The key is using interference patterns, in which different wavelengths of light sometimes reinforce each other and in other places cancel each other out. The researchers exposed the photochromic material — one that changes its color, and therefore its [transparency](#), in response to light — to a pair of such patterns, each of a different wavelength, simultaneously. When the bright lines at one wavelength coincide with the dark lines at the other wavelength, extremely narrow lines of clear

material are formed interspersed with the opaque material. This banded layer then serves as a mask through which the first wavelength illuminates a layer of material underneath, similarly to the way a photographic negative is used to make a print by shining light through it onto a sheet of photo paper underneath.

The research was carried out by research engineer Rajesh Menon of the Research Laboratory of Electronics and graduate students Trisha Andrew in the Department of Chemistry and Hsin-Yu Tsai in the Department of Electrical Engineering and Computer Science, and is reported in a paper published in the April 10 issue of *Science*.

Remarkably, the new technique, which the researchers call absorbance modulation, makes it possible to create lines that are only about one-tenth as wide as the [wavelength](#) of light used to create them. Part of the trick was to find a suitable photochromic material whose clear and opaque parts would remain stable after the initial exposure to light.

Using this method, the team produced lines just 36 nanometers wide, and say they could also place many such lines spaced a similar distance apart.

Such a technique could "could have a significant impact on chip making," Menon says, and could also help to enable new work in a variety of emerging fields that rely on nano-scale patterning, including nanophotonics, nanofluidics, nanoelectronics, and nano-biological systems.

Already, a company has been formed to develop this technology, and Menon says he expects it to lead to commercial production within five years.

But that's not the only potential application of the approach. Menon says

his team is pursuing possible use of the same system for imaging systems, which could enable new kinds of microscopes for observing at nanoscale resolution, with possible applications in biology and in materials science. At the same time, he is pursuing ways of using the technique to create even smaller patterns, down to the scale of individual molecules.

Provided by Massachusetts Institute of Technology ([news](#) : [web](#))

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