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U. ILLINOIS SETS NEW LEVEL IN STRUCTURE MOLDING

U-WIRE

Feb. 7, 2005 - University of Illinois faculty and students at the Beckman Institute and the Materials Research Lab have spent the past year creating molds of structures just a few molecules long, smaller than any achieved before.

Their findings were published in the December issue of the journal Nano Letters.

The researchers used a process known as polymer nanoimprint lithography that could be used in the future to make microchips or other minute products, said John Rogers, a professor of materials science and engineering.

The process, which involves immersion of tiny objects in liquid polymers to create molds, is already in use, but the team approached the limits of how small the molds could be by varying the polymer's molecular structure.

"This [project] was especially interesting, because there's not just the pure science aspect of it, there's also the real, immediate uses that it will have," Rogers said.

Currently, microchips and other small structures are made through a process that uses light to shape polymers. However, the wavelengths of the photons limit how small the created objects can be.

Once those limits are reached, Rogers said, a new technique will be needed. Nanoimprint lithography is one possible replacement.

"There are a lot of factors that will determine what process will be used," Rogers said. "But we've established that, as far as the scales we can produce, nanoimprint lithography is as good as it gets."

Much of the in-lab work was done by Feng Hua, a post-doctorate student in materials science and engineering.

Hua said the group would continue to push the scale possibilities of the technique and also look at its other uses. For instance, by creating tiny channels on a nanometer scale, scientists could study fluid flow at a molecular level.

The group first grew tiny tubes made of carbon on small pieces of silicon, then poured a liquid polymer over them to create the mold. Pressing the molds into layers of silicon allowed them to replicate the tubes' patterns.

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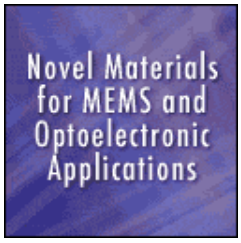

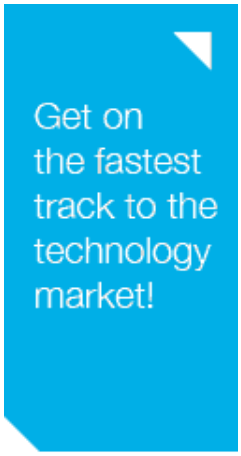

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Michael Strano, an associate chemical and biomolecular engineering professor who was not involved with the project, praised the group's work.

"Transfer printing is a way of making lithography much cheaper and more accessible, and they answered the question of just how small it can go," Strano said. "It's the first time individual molecules have ever been imprinted."

Rogers said the molds were so small, studying them became a problem.

"The hardest part wasn't necessarily creating the molds -- but once you do, how do you look at it to prove that you created them?" Rogers said.

To look at the patterns, the team collaborated with University experts in nanoimaging. Dow Corning, a leading silicon supplier, also assisted with and funded the project in hopes of using the technique in the future, Rogers said.

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