Method for Preparing Nanoporous Cell-Scaled Reaction Vessels

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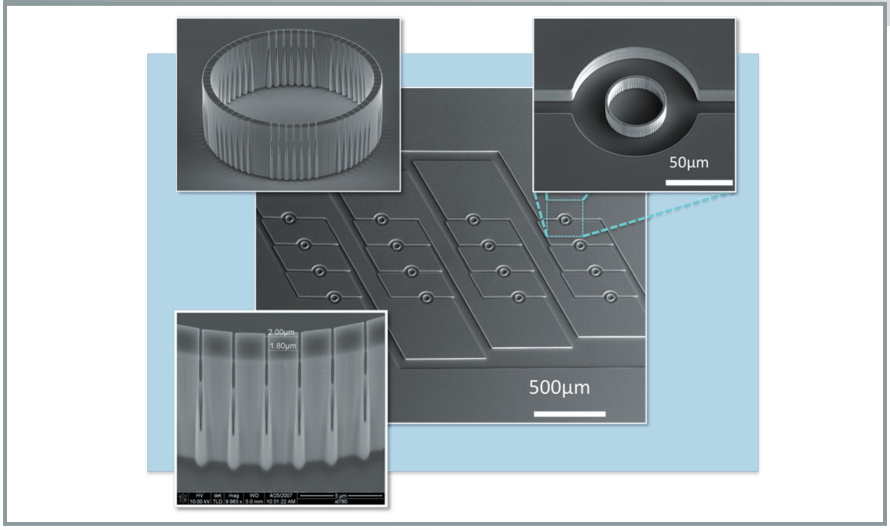

Technology Summary

Researchers at ORNL developed a method to engineer and fabricate nanoscale reaction vessels that mimic biological cells. The picoliter-size reaction vessls have nanoscale pores that allow molecules to enter and exit based on their size, much as molecules do in living cells. This method can eventually be used to contain and create more complex networks. The invention holds great promise for industry and research, where synthetic biologists can match the scale of biological systems and create biologically inspired devices.

In this invention, a reaction vessel is made in a microchannel by etching a substrate. The microchannel has a width of 1000 micrometers (millionths of a meter) or less and the device has side walls on the order of 2 micrometers. Pores in the sidewall of the device have a width of 1 to 500 nanometers (billionths of a meter) and are etched to create an opening between the interior of the vessel and the microfluidically controlled environment. Nucleic acids and enzymes can then be located inside the vessel and the pores can be modified to have physical or chemical properties that selectively restrict passage of these materials into or out of the vessel. Further, a coating on the pore can be used to control the pore opening when a signal is applied.

Biochemical reactions such as protein synthesis and enzymatic conversion are fundamental to the functioning of living systems and serve as vital tools in industry and research. Nanotechnology-based devices made possible by this invention can be used to produce pharmaceutical products and to better understand molecular systems, self-organization, and enzymatic reactions at the microscale level.

Advantages

- Cell-mimicking structures can be prepared as isolated cells or arrays of cells
- Opportunities to match the scale of complex biological system components and create biologically inspired devices
- Variety of high-aspect-ratio, nanoporous silicon structures can be integrated into devices within a microfluidic network

Potential Applications

- Fundamental studies of protein-based complex reaction systems
- Assembly and testing of genetic networks
- Analysis of single cells
- Reaction systems and material organization in a fluid environment
- Cell-free protein synthesis and transcription and translation reactions
- Enzymatic reactions at the microscale
- Responsive sensors and therapeutic platforms for developing biological materials
- Probing and manipulating biological systems to perform new functions

Patent

Scott T. Retterer and Mitchel John Doktycz, *Method for Preparing Small Volume Reaction Containers*, U.S. Patent Application 13/050,478, filed March 17, 2011.6.

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