delivered a lithium insertion capacity correlating to 8.6 mol lithium per mol WS_2 nanotube whereas the lithium insertion capacity was 0.6 mol lithium per mol crystalline WS_2. The researchers attribute the nanotube capability to its 1D topology and open structure. They further found that the WS_2 nanotubes show stable cyclability over a wide voltage range (0.1–3.1 V vs. Li/Li^+), so that batteries built with these materials will be tolerant for overcharge and overdischarge. Based on their results, the researchers said that WS_2 nanotubes may be an attractive material for usage in electrochemical applications. In particular, they said, the capacity for storing Li is much enhanced in the nanotube modification of the material than the crystalline powder materials.

MARKUS J. BUEHLER

Fabrication of Suspended Micro- and Nanostructures Accomplished by Direct Drawing of Polymer Fibers

In designing and fabricating micro- and nanostructures, ease of fabrication is an important consideration. S. Harfenist, R.W. Cohn, and co-workers at the ElectroOptics Research Institute and Nanotechnology Center in the University of Louisville have demonstrated a simple and versatile method for creating suspended micro- and nanostructures by direct drawing of fibers from liquid polymers. The novelty of this approach is that it offers control and flexibility of forming and simultaneously patterning polymer fibers as suspended bridges and networks of three-dimensional structures.

As reported in the October 13 issue of *Nano Letters* (p. 1931), the researchers used tips attached to an atomic force microscope (AFM) or a computer-controlled micromill to draw fibers from a drop of poly(methyl methacrylate) (PMMA) electron beam resist placed on a substrate. The tip was dipped into the polymer drop several times until a fiber formed between the tip and the drop. The tip end of the fiber was drawn to a second drop of liquid polymer or adhered to a surface to form a polymer fiber that dries and solidifies into a suspended beam. The fibers produced were circular and uniform in diameter ranging from under 50 nanometers to tens of microns and can be made to span lengths from a few microns to several centimeters. This approach can be modified to produce suspended fibers in parallel and to pattern and orient them into three-dimensional geometries. For example, a bead of liquid polymer applied and allowed to dry momentarily on the edge of a stiff sheet of plastic or a microscope glass slide before being quickly dragged over an array of sharp silicon tips results in fibers suspended along each row of tips (see Figure 1). In a different example, polymer fibers several centimeters long can be drawn by hand on the cleaved end of a glass optical fiber and can be repeatedly manipulated and coiled without breaking. Fibers have been formed at draw rates between 10 μm/s and 100 mm/s, depending upon experimental conditions.

According to the researchers, polymer fibers formed and patterned by this approach may be applied as three-dimensional templates for subsequent processing. Capillaries with different functionality can be produced by coating the

https://doi.org/10.1557/mrs2004.223 Published online by Cambridge University Press

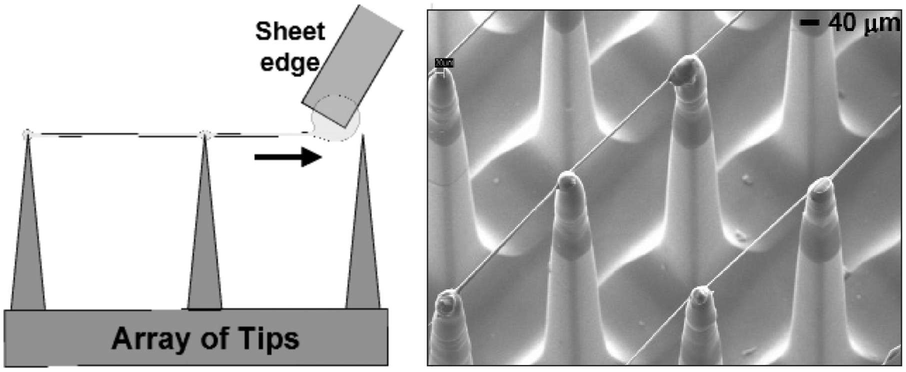

Figure 1. Fabrication of suspended nanostructures by direct drawing of polymer fibers. A drop of polymer is applied at the edge of a sheet and quickly drawn across a tip array creating multiple suspended parallel fibers.

polymer fibers with desired materials using various deposition techniques followed by selective removal of the polymer core. The researchers demonstrated capillaries in chrome, parylene, gold, and glass.

The speed and ease of fabrication by this direct-drawing method compared to conventional multi-step lithography, together with choice of polymer with desirable properties, opens the possibility of applications in the fabrication of microfluidic devices, and optical and sensing elements.

SOMA CHATTOPADHYAY

Use of Centrifuge Force to Fabricate Reticulated Porous Ceramics Results in Uniform Structure

Reticulated porous ceramics (RPCs) are synthesized materials composed of an arrangement of superimposed ceramic lattices. These materials exhibit porosity higher than 70%. Control of the pore structure is key for application of RPCs. A common method for manufacturing RPCs consists in immersing a polyurethane sponge in prepared ceramic slurry, removing the excess slurry by roll pressing and then sintering. However, the roll-press method does not effectively remove the excess slurry accumulated in the joints of the lattice. An alternative process to remove the excess slurry from the preform by utilizing centrifugal force has been presented by X. Pu, X. Liu, F. Qiu,

https://doi.org/10.1557/mrs2004.223 Published online by Cambridge University Press