Electrodeposition of Patterned Metal and Semiconductor Microwires on Ultrananocrystaline Diamond Electrodes

Daniel A. Dissing[1*], David B. Seley[1], Anirudha V. Sumant[2], Ralu Divan[2], Orlando Auciello[2,3], Suzanne Miller[2], Eric A. Terrell[1*], Michael P. Zach[1]
[1]Department of Chemistry, University of Wisconsin – Stevens Point, Stevens Point, WI 54481; [2]Center for Nanoscale Materials, Argonne National Laboratory, Argonne, IL 60439; [3]Materials Science Division, Argonne National Laboratory, Argonne, IL 60439; *denotes undergraduate student authors. MZach@uwsp.edu

Many methods exist for making nanowires. Some inexpensive methods produce short and straight, or long and tangled, or randomly arrayed wires. Many techniques are highly specific for only a few materials. The few techniques that give high resolution such as electron beam lithography or extreme UV lithography are very expensive. Menke and Penner recently produced patterned arrays of nanowires using localized electrodeposition onto the exposed edges of thin metal layers covered with photoresist.(1) In that method the template for growing wires was destroyed in making each copy, thus requiring complete synthesis of a new template for each new set of nanowires.

Missing from all the reported methods for making nanowires is a technique that can produce large numbers of complex patterned nanowires with controlled diameters from many materials using a reusable template.

Here we demonstrate a new method consisting of a layered electrode composed of conductive and non-conductive ultrananocrystalline diamond (UNCD) that produces consistent, patterned micro- and nanostructures of high uniformity. This technique is very general allowing wires to be made from nearly any material that can be electrodeposited. Conductive nitrogen doped UNCD works as an efficient electrode and at the same time provides a robust substrate with an extremely large electrochemical window due to its chemically inert nature. Undoped diamond does not allow electrochemical reduction of materials upon the surface.

The multilayer diamond electrode is a permanent template for synthesis of micro- and nanowires with low adhesion to most materials allowing for easy transfer of wires onto an adhesive polymer thus regenerating a pristine, like-new electrode. Mass production of nanowires becomes almost as simple as using a rubber stamp and ink. Materials electrodeposited, so far, include: Pb, Au, Cu, Pd, Pt, Co (non-aqueous), Te, CdTe, and CdS.

1 E. J. Menke, M. A. Thompson, C. Xiang, L. C. Yang and R. M. Penner, *Nature Materials*, **5**, 914 (2006).

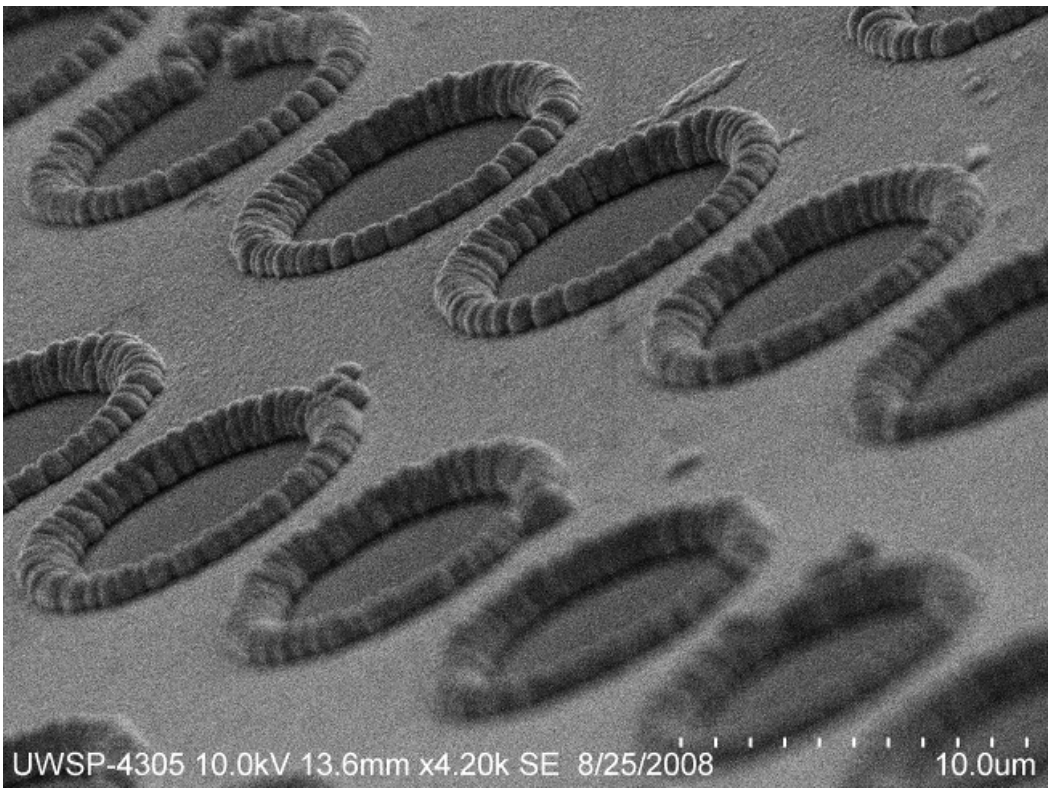

Figure 1 – Scanning electron microscope image of cadmium telluride microwires electrodeposited onto ultrananocrystalline diamond electrodes.

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