Self-Assembled Al Nanopipes and Al-Al_2O_3-Pt Nanocoaxes via ALD

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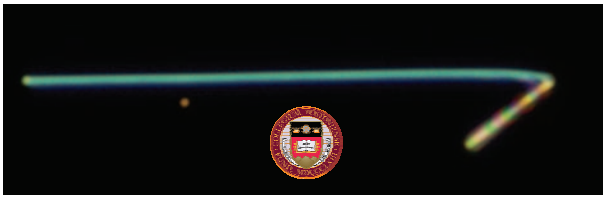
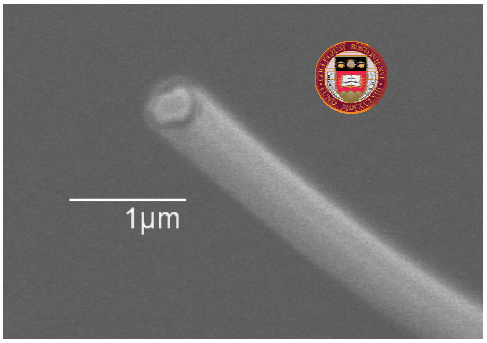
We have developed a self-assembly process to grow aluminum nanopipes using ALD. HRTEM and EDS show the nanopipes to be composed of polycrystalline FCC Al, with crystallite size ~10 nm. SEM investigation reveals that the nanopipe inner diameters range from 100 to 500 nm, with ~20 nm wall thickness and up to 200 μm length. We have further used these nanopipes as the cores of nanocoaxes by coating them with Al_2O_3 and Pt, both via ALD. This appears to be the first observation of Al nanopipe/nanotube growth. Both the pipe and coax nanostructures have potential utility in optical waveguiding,[1,2] high efficiency photovoltaics,[3] and biochemical sensing,[4] among other possibilities.

1. J. Rybczynski, K. Kempa, A. Herczynski, Y. Wang, M.J. Naughton, Z.F. Ren, Z.P. Huang, D. Cai, and M. Giersig, "*Subwavelength waveguide for visible light*", Applied Physics Letters **90**, 021104 (2007).
2. K. Kempa, X. Wang, Z.F. Ren, and M.J. Naughton, "*Discretely guided electromagnetic effec-tive medium*", Applied Physics Letters **92**, 043114 (2008).
3. M.J. Naughton *et al.*, "*Efficient nanocoax-based solar cells",* Physica Status Solidi RRL **4**, 181 (2010).
4. H.Z. Zhao, M.J. Naughton, *et al.*, "*An ultrasensitive chemical sensor based on nanoscale coaxial arrays*", (submitted, 2011).





Left: Dark-field optical micrograph of 50 μm-long Al nanopipe (with ~10 μm-long 2nd section) formed via self-assembly ALD.
Right: Nanoscale coaxial cable (nanocoax) formed entirely by ALD, with inner conductor by self-assembled Al nanopipe, dielectric annulus by conventional ALD Al_2O_3 and outer conductor by Pt ALD.

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