

Supporting Information

Large Scale Fabrication of Single Crystalline Tin Nanowire Arrays

*Bin Luo, Dachi Yang, Minghui Liang, Linjie Zhi**

National Center for Nanoscience and Technology of China, Beiyitiao 11, Zhongguancun, Beijing, 100190, P. R. China

** Email: zhilj@nanoctr.cn; Fax: 0086-10-82545578*

Experimental details

High-purity aluminium foils (99.999%, 0.25 mm in thickness) were used as the starting material. Before anodization, the aluminium foils were degreased in acetone, and then annealed in a purified argon atmosphere at 550°C for 4 h to remove the mechanical stress and recrystallize the foils. Then the aluminium foil was electropolished under constant current conditions of 90 mA cm⁻² for 3 min in a mixture of HClO₄ and C₂H₅OH at room temperature to smooth the surface morphology. The anodic aluminium oxide (AAO) membrane was prepared in a two-step anodizing process. The aluminium foil was first anodized in 0.3 M oxalic acid (H₂C₂O₄) electrolyte at 60 V. The temperature of the electrolyte was kept at 0-5°C; after first anodization for 5 h, the AAO membrane was immersed in an etching solution of 6 wt% H₃PO₄ and 1.8 wt% H₂CrO₄ at 60°C for 5 h to remove the alumina layers. Then the aluminium foil was anodized again under the same conditions as the first step. The aluminium layers remaining on the bottom of the AAO membrane could be removed in 1 M CuCl₂ solution. A subsequent etching treatment was carried out in 5 wt% H₃PO₄ at room temperature for 1-2 h to remove the barrier on the bottom side of the AAO membrane and to widen the pores.

A gold layer was sputtered onto the back side of the AAO membrane as an electrode. Prior to tin deposition, short copper nanorods were deposited to fill in the bottom of the nanopores and were used as the second electrodes. An aqueous bath containing 0.2 M CuSO₄·5H₂O and 0.1 M H₃BO₃ was selected as electrolyte and a galvanostatic (2.0 mA cm⁻²) process was performed for 40 seconds at room temperature. The pH value of the solution was controlled in the range from 4.5 to 5.0 by adding 0.1 M H₂SO₄ solution. Tin nanowires was deposited on the copper nanorods in an

electrolyte containing $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ (0.05-0.3 M), boric acid (0.05-0.2 M) and sodium citrate (0.05-0.2 M) at 20°C , using graphite as counter electrodes. The initial pH value of the aqueous phase was controlled in the range from 1.0 to 3.0. The electrodeposition was performed under galvanostatic (Sample 1: 1.0 mA cm^{-2} ; sample 2: 2.0 mA cm^{-2}) or potentiostatic (Sample 3: 0.5 V; sample 4: 1.2 V) technique for 30-60 min at room temperature.

The morphologies of deposited metallic nanowires were obtained by scanning electron microscope (Hitachi S-4800). The structure of metallic nanowires was characterized by X-ray diffraction (XRD) (Rigaku D/max-2500B2+/PCX system) and Transmission Electron Microscope (TEM, Tecnai G2 20ST). For TEM observations, the back surface of the Sn nanowire arrays is first polished away with alumina powder to remove the sputtered gold layer, and then the AAO was partly dissolved with 1 M NaOH solution and polished again with alumina powder to remove the copper nanorods. And finally the residual AAO was completely dissolved in diluted NaOH solution (pH=12), the solution was then slowly removed via syringe and the sample was carefully rinsed with absolute ethanol.

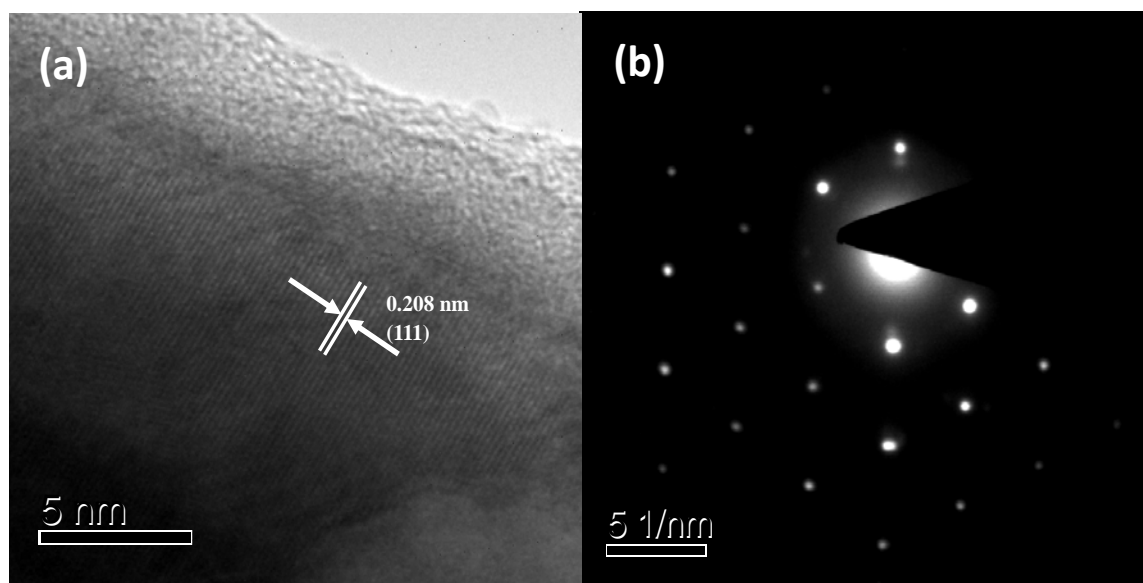


Fig. S1 TEM investigations of the individual Cu nanorods: (a) high magnification TEM image of a single Cu nanorod; and (b) corresponding SAED patterns of the Cu nanorod shown in (a)