Poster

ASSEMBLY AND ELECTRICAL CHARACTERISATION OF NANOWIRES

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The work presented details assembly methods and electrical transport measurements for multicomponent nanowires fabricated by template deposition. Template deposition describes a fabrication technique where structures are grown within a porous scaffold which defines their size and shape. Coupling this technique with nanoporous membranes has allowed the creation of structures in nanoscale[1].

Porous alumina membranes were chosen as the template scaffold because they are perforated by uniformly sized, straight, close-packed pores which penetrate perpendicularly through the entire thickness of the membrane[2]. Nanowires were grown from an electrode evaporated onto the base of the membrane using both electrochemical and electroless gold deposition techniques[3]. By temporarily halting the growth process, junctions of molecular monolayers or nanoparticles could be incorporated into the wire structure. The scale of the nanowires is constrained by the size of the template, typically nanowires are 150nm in diameter and can be grown many microns in length, figure 1. Dispersions of nanowires in solution were used for further manipulation and analysis, obtained by chemically etching the template host.

Directed assembly techniques have been used to position and align nanowires onto surfaces and electrodes. Surface properties of gold substrates were manipulated using patterned Self-Assembled Monolayers (SAMs) to control either their wetting or electrostatic properties. Nanowires with complementary surfactant coatings are self-assembled from solution into specific locations and orientations defined by the pattern design.

Transport measurements of single nanowires have been enabled by their assembly between lithographic electrodes figure 2. Under the influence of an alternating field, nanowires in solvent solutions experience a dielectrophoretic force that produces net movement towards the electrode, and alignment with the field lines. Whilst continuous gold wires display an ohmic response, this can be manipulated by the incorporation of SAMs junctions along the length of the wire[4]. It is expected that such nanoscale devices will display novel electronic properties.

References:

1. Martin, C.R., *Nanomaterials: A membrane-based synthetic approach.* Science, 1994. **266**: p. 1961 - 1966.
2. Li, A.P., et al., *Fabrication and microstructuring of hexagonally ordered two-dimensional nanopore arrays in anodic alumina.* Advanced Materials, 1999. **11**(6): p. 483 - 487.
3. Huczko, A., *Template-based synthesis of nanomaterials.* Applied Physics a-Materials Science & Processing, 2000. **70**(4): p. 365-376.
4. Mbindyo, J.K.N., et al., *Template synthesis of metal nanowires containing monolayer molecular junctions.* Journal of the American Chemical Society, 2002. **124**(15): p. 4020-4026.

Figures:

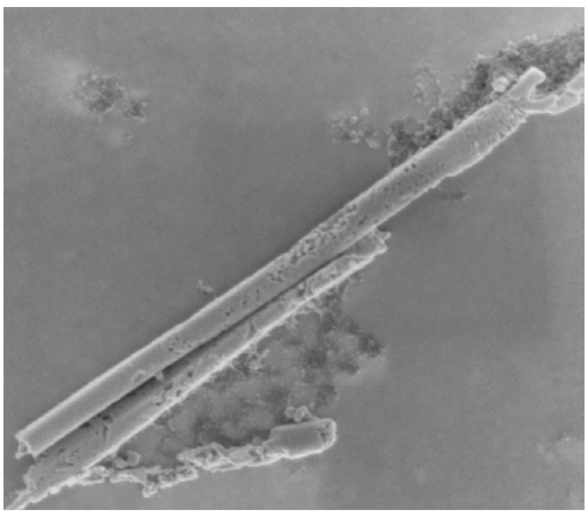

Figure 1
SEM of 150nm diameter nanowire on Si.

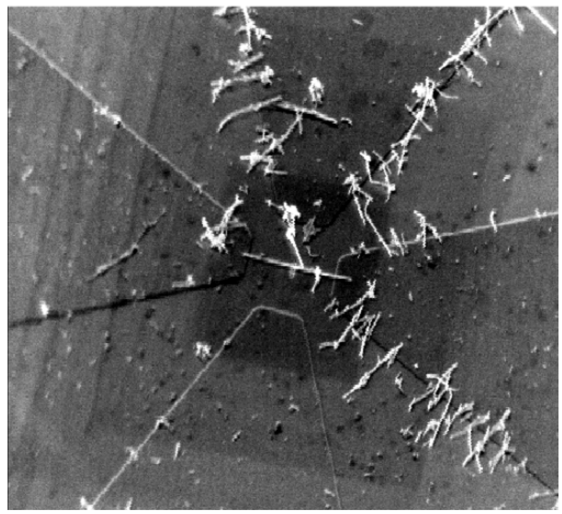

Figure 2
SEM of nanowires assembled at electrode edge.