359h Nanowire Diameter Control from Film Thickness at Cleaved Edges of Thin Film Multilayer Patterns

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Due to their micron scale length, nanotubes and nanowires can be manipulated with current micro fabrication techniques and self assembly processes yet result in nanometer scale lines. The primary challenge is to control the location and diameter of these nanowires or tubes. An approach investigated here is to utilize the edge of thin film multilayer patterns where the thickness of an exposed face of a catalyst layer determines the diameter of nanotubes grown from it. This can in turn be incorporated into photolithographically defined ‘post' structures for a scalable nm-lithography process. Selective CVD growth of carbon nanotubes (CNTs) from narrow lines (12-60nm) of SiO2, Fe, Ni, Co at the edge of patterned multilayer thin films show resulting CNT diameter to be equal to catalyst film thickness. The concept has also been extended to VS growth of CuO nanowires in a Al2O3/Cu(40-100nm)/Al2O3 thin film multilayer structures and VLS growth of ZnO nanowires. Line-of-site shadow widths for multiwalled carbon nanotubes that are suspended over a Si3N4 membrane TEM grid have been directly quantified by STEM. Al evaporation at incident angles of 0.7 to 2.0 degrees resulted in shadow widths to be up to 7nm narrower than simple line-of-site geometry prediction. Thus surface migration needs to be accounted for in nano-scale shadow lithography processes.