Non-Lithographic Fabrication of Nanometric Superlattices

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Nanoscaling of conventional materials can generate unconventional physical properties [1-3]. Although the focus has so far been placed on individual nanostructures [1-3], the collective behaviors of nanostructures in a large ensemble have great potential for they may enable effects and applications that have no classic or individual-based counterparts. However the assembly and manipulation of multiple nanostructures into highly ordered arrays and functional units are very challenging.

In this work, we present a study aimed at developing a non-lithographic fabrication platform for nanometric superlattices. A large variety of uniform, hexagonally ordered nanostructure arrays, such as metal nanodots and antidots, metal oxide nanodots and nanowires, semiconductor nanodots, nanopillars and nanopores, heterostrucutre quantum dots and organic-inorganic nanocomposite, were fabricated with the same ease. The key elements of this platform include the formation of an alumina nanopore arrray membrane, the the transport and placement of the membrane onto the target material substrate, and the subsequent combination of evaporation and etching through the membrane to transfer the nanopore array pattern (Fig. 1). This nanofabrication approach is attractive for it is applicable to many materials and is scalable in both array and feature sizes beyond the reach of standard e-beam lithography. Characterized by XRD, Raman spectroscopy and photoluminescence studies, the resultant superlattices are shown to exhibit superior and often unique properties desirable for many applications.

Reference

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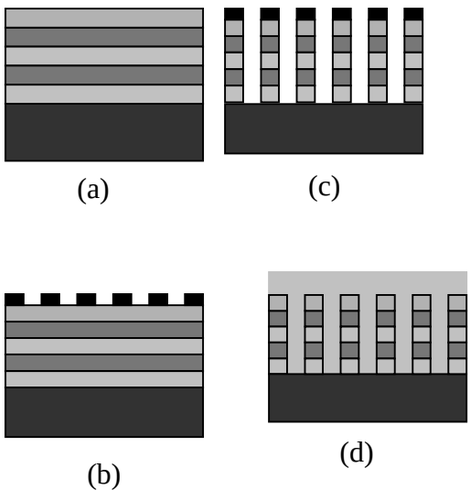

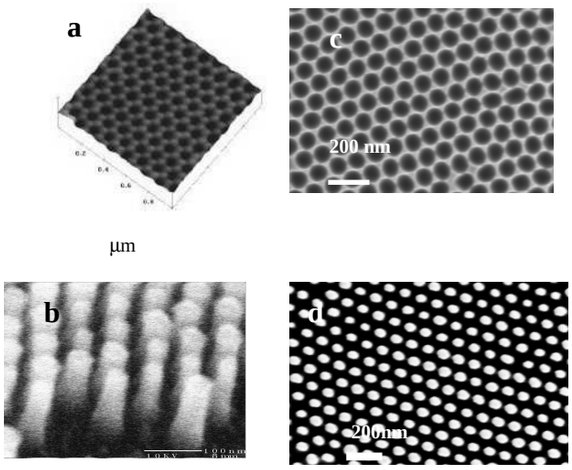

Fig 1 (a) AFM top view of Au-coated AAO template; (b) SEM oblique views of AlGaAs/GaAs 3-D q-dot arrays as schematically shown in the figure below; (c) SEM tope view of an anti-dot array in GaN substrate; (d) SEM top view of TiO_2 nanodot arrays on Si.