Templated Bottom-up Growth of High-density Sb_2Te_3 Nanopillars by MOCVD.

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ABSTRACT

Bottom-up nanofabrication of materials that self-assemble into well-defined morphologies, patterns and shapes is a leading trend in Nano-electronic devices[1]. Chalcogenide nanostructures like Sb_2Te_3 offer superior properties for applications such as phase change memory[2], spintronics[3] and thermoelectric devices[4]. Precise control and optimization of growth is a key factor in determining the ultimate properties of the nanostructures. In the current work, we have successfully demonstrated that the Metal Organic Chemical Vapor Deposition (MOCVD) can be employed to grow high aspect ratio nanostructures in templates. We used porous Anodic Aluminum Oxide (AAO) templates[5] (gold functionalized) to grow Sb_2Te_3 nanopillar arrays. The obtained nanopillar arrays have very high density of $\sim 3\times10^{11}$ per inch^2 with nanopillars diameter of 20-25 nm and height of 200 nm. The morphology, composition and crystallinity of nanopillars were characterized by SEM, TEM-EDX, XRD & Raman. Additional post-growth processing techniques, such as chemical etching and soft mechanical polishing of AAO templates, were carried out on selected samples, which are useful for functional characterization and device fabrication. In principle, the results of this work can be extended to other chalcogenide systems ($Ge_2Sb_2Te_5$, Bi_2Se_3, Bi_2Te_3, etc.) to obtain highly dense arrays of chalcogenide nanostructures.

References:

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