Synthesis and characterization of single crystalline Germanium nanowires

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Abstract: One-dimensional (1D) Ge nanostructures such as single crystalline nanowires have attracted intense research zeal in the past decade as compared to its bulk form, owing to their wide range of potential applications in sensing, biology, optoelectronics, solar cells and photocatalysis. In this work, by optimizing the experimental conditions using simple vapor transport method, single crystalline germanium nanowires with lowest diameter were successfully synthesized and characterized.

Keywords: Germanium, Nanowires, single crystalline, Nanostructures

Introduction:

Nanomaterials are commonly defined as materials designed and produced to have structural features with at least one dimension of 100 nanometers or less. Various types of nanomaterials attract tremendous attention in recent researchers. New physical properties and new technologies both in sample preparation and device fabrication evoke the development of nanoscience. Dimensionality is an important governing factor in the electronic structures of semiconductor nanocrystals. The quantum confinement energies in two-dimensional quantumwells, one-dimensional quantum wires and zero-dimensional quantum dots are quite different [1-8]. Semiconductor nanocrystals, such as quantum dots (QDs) and quantum wires (QWs), are of intense scientific and technological interest. One-dimensional (1D) nanostructures suchas wires, rods, belts, and tubes have also become the focus of intensive research owing to theirunique applications in mesoscopic physics and fabrication of nanoscale devices [9,10]. It is generally accepted that 1D nanostructures provide a good system to investigate the dependenceof electrical and thermal transport or mechanical properties on dimensionality and size reduction (or quantum confinement). 1D nanostructures can now be fabricated using a numberof advanced nanolithographic techniques, such as electron-beam (e-beam) or focused-ion- beam (FIB) writing, proximal- probe patterning, and X-ray or extreme-UV lithography. The vapor-liquid-solid method (VLS) is a mechanism for the growth of one-dimensional structures,such as nanowires, from chemical vapor deposition or physical vapor deposition [11]. Growthof a crystal through direct adsorption of a gas phase on to a solid surface is generally very slow.The VLS mechanism circumvents this by introducing a catalytic liquid alloy phase which canrapidly adsorb a vapor to supersaturation levels, and from which crystal growth can subsequently occur from nucleated seeds at the liquid-solid interface. The physical characteristics of nanowires grown in this manner depend, in a controllable way, upon the size and physical properties of the liquid alloy. For the gold germanium system, eutectic