Journal of Applied Sciences 11 (8): 1401-1405, 2011
ISSN 1812-5654 / DOI: 10.3923/jas.2011.1401.1405

Growth and Characterisation of ZnSe Semiconductor Nanowires

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Abstract: The growth and characteristics of wide gap II-VI semiconductor nanowires prepared by the so-called Vapour-Liquid-Solid (VLS) technique was presented ZnSe nanowires were prepared on Si (111) by using Au as catalyst. Vapor-Liquid-Solid (VLS) process under certain conditions to form the desired nanowires. The as-synthesized products were characterized by SEM and EDX. The SEM analysis of ZnSe nanowires indicated that nanowires grow randomly at angles widely different from the vertical.

Key words: Nanotechnology, ZnSe nanowires, VLS, semiconductors, SEM, EDX

INTRODUCTION

Nanotechnology is a cutting age technology and has many potential applications which can be divided into short-term and long-term applications. The short term is to enrich scientific research to develop the characteristics and effectiveness of nano-materials. On the other hand, long term applications is to build nano-devices using atoms and molecules. Nanotechnology is a new branch of engineering, based on the physics of low dimensional structures. This technology increases the ability to design and build devices on an atomic or molecular scale and provides opportunities to develop materials with unique properties. Nanostructured materials are systems in which the physical size in at least one dimension is less than or equal to 100 nm. They are important for both fundamental research applied oriented research since they have the potential to reach far higher device densities compared to traditional material technology. The properties of nanostructures are not only dependent upon dimensionality, but also their physical size.

In semiconducting materials electrons live in a range of define energy level called bands. The conduction band is partially filled band are areas where electrons are missing, known as hole. The advantage of nanotechnology enables much larger surface area hence much more active electrons. The Fermi level (a band gap) are reduced giving advantage to one kind of nanostructured materials is one-dimensional (1D) nanowires. They were first discussed in 1980 (Sakaki, 1986), for application to high electron mobility channels. An important advantage of 1D nanowires over other low dimensional material is that the nanowires can function as both active device elements and interconnects carrying current to and from devices.

Vapor-Liquid-Solid(VLS) process was established in the 1960's by Wanger and Ellis (1964), later justified thermodynamically and kinetically (Givargizov, 1975). It was recently reexamined by Lieber, Yang (Gudiksen *et al.*, 2000), other researchers to generate nanowires and nanorods from a rich variety of inorganic materials (Shi *et al.*, 2001; Wang *et al.*, 2002; Wu *et al.*, 2002). A typical VLS process starts with the dissolution of gaseous reactants into nanosized liquid droplets of a catalyst metal, followed by nucleation and growth of single-crystalline rods and then wires. The one-dimensional growth is induced and dictated by the liquid droplets, whose sizes remain essentially unchanged during the entire process of wire growth. Each liquid droplet serves as a virtual template to strictly limit the lateral growth of an individual wire.

In this process, the anisotropic crystal growth is promoted by the presence of the liquid alloy/solid interface. The VLS process has now become a widely applied to explain the growth of various nanowires from a rich variety of pure and doped inorganic materials that include elemental semiconductors (He *et al.*, 2001; Duan and Lieber, 2000; Chen *et al.*, 2001) and II-VI semiconductors (Lopez-Lopez *et al.*, 1998; Zhang *et al.*, 2001).

This study premise deals method with fabrication of ZnSe nanowires using VLS process. Stringent control over the conditions of the ZnSe nanowires were identified. This study should help to identify the conditions suitable for fabricating optimized ZnSe nanowires and their associated device (transistor) characteristics. In particular, ZnSe is being actively studied as a result of recent success in the fabrication of blue-green Light Emitting Diodes (LED).

MATERIALS AND METHODS

The experimental setup used in this work is illustrated in Fig. 1.