A-11

Effects of the buffer layer annealing and post annealing temperature on the structural and optical properties of ZnO nanorods grown by a hydrothermal synthesis

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The zinc oxide (ZnO) material as the II–VI compound semiconductor is useful in various fields of device applications such as light-emitting diodes (LEDs), solar cells and gas sensors due to its wide direct band gap of 3.37eV and high exciton binding energy of 60meV at room temperature.

In this study, the ZnO nanorods were deposited onto homogenous buffer layer/Si(100) substrates by a hydrothermal synthesis. The Effects of the buffer layer annealing and post annealing temperature on the structural and optical properties of ZnO nanorods grown by a hydrothermal synthesis were investigated. For the buffer layer annealing case, the annealed buffer layer surface became rougher with increasing of annealing temperature up to 750°C, while it was smoothed with more increasing of annealing temperature due to the evaporation of buffer layer. It was found that the roughest surface of buffer layer improved the structural and optical properties of ZnO nanorods. For the post annealing case, the hydrothermally grown ZnO nanorods were annealed with various temperatures ranging from 450 to 900°C. Similarly in the buffer layer annealing case, the post annealing enhanced the properties of ZnO nanorods with increasing of annealing temperature up to 750°C. However, it was degraded with further increasing of annealing temperature due to the violent movement of atoms and evaporation. Finally, the buffer layer annealing and post annealing treatment could efficiently improve the properties of hydrothermally grown ZnO nanorods.

The morphology and structural properties of ZnO nanorods grown by the hydrothermal synthesis were measured by atomic force microscopy (AFM), field emission scanning electron microscopy (SEM), and x-ray diffraction (XRD). The optical properties were also analyzed by photoluminescence (PL) measurement.

Keywords: Annealing treatment, ZnO, Hydrothermal synthesis

A-12

SiGe Nanostructure Fabrication Using Selective Epitaxial Growth and Self-Assembled Nanotemplates

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Nanostuctures such as nanodot and nanowire have been extensively studied as building blocks for nanoscale devices. However, the direct growth of the nanostuctures at the desired position is one of the most important requirements for realization of the practical devices with high integrity. Self-assembled nanotemplate is one of viable methods to produce highly-ordered nanostructures because it exhibits the highly ordered nanometer-sized pattern without resorting to lithography techniques. And selective epitaxial growth (SEG) can be a proper method for nanostructure fabrication because selective growth on the patterned openings obtained from nanotemplate can be a proper direction to achieve high level of control and reproducibility of nanostructucture fabrication. Especially, SiGe has led to the development of semiconductor devices in which the band structure is varied by the composition and strain distribution, and nanostructures of SiGe has represented new class of devices such nanowire metal-oxide-semiconductor field-effect transistors and photovoltaics. So, in this study, various shaped SiGe nanostructures were selectively grown on Si substrate through ultrahigh vacuum chemical vapor deposition (UHV-CVD) of SiGe on the hexagonally arranged Si openings obtained using nanotemplates. We adopted two types of nanotemplates in this study; anodic aluminum oxide (AAO) and diblock copolymer of PS-b-PMMA. Well ordered and various shaped nanostructure of SiGe, nanodots and nanowire, were fabricated on Si openings by combining SEG of SiGe to self-assembled nanotemplates. Nanostructure fabrication method adopted in this study will open up the easy way to produce the integrated nanoelectronic device arrays using the well ordered nano-building blocks obtained from the combination of SEG and self-assembled nanotemplates.

Keywords: SiGe Nanostructure, Selective Epitaxial Growth, Self-Assembled Nanotemplates