CONTROLLED SYNTHESIS OF ZNSE NANORINGS AND NANOWIRES BY THERMAL EVAPORATION

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One dimensional semiconductor nanostructures have drawn a considerable amount of attentions due to their potentials in understanding fundamental physics in small scales and their potentials in fabricating nanoscale optoelectronic devices. Many semiconductors of interest have been synthesized in one-dimensional forms such as wires, belts and tubes by various methods [1]. Among these, ZnSe, a II-VI semiconductor of room temperature band gap energy of 2.7 eV, has attracted extensive attention due to its wide applications in blue-green light-emission and diode laser structures [2].

One of the key components for the manufacturing nanoscale devices is controlled synthesis. In this study, free standing crystalline ZnSe nanorings as shown in Fig. 1 and nanowires as shown in Fig. 2 have been fabricated on Au coated Si substrates by simple thermal evaporation of ZnSe powders. Ring- or wire-like morphology can be achieved in a controllable manner by using different reactor pressures during growth, while all the other conditions remain the same. To our knowledge, ZnSe rings have not been reported to date. It is also worth to notice that unlike other wurtzite structured binary semiconductors such as ZnO and GaN, which are intrinsically anisotropic with a unique c-axis that readily result anisotropic morphologies like wires, belts and even rings [3], ZnSe is usually zinc-blended structured which makes it more difficult to grow in anisotropic forms. The growth mechanism of the nanorings will be discussed.

The as-synthesized products have been characterized by scanning electron microscopy, transmission electron microscopy, X-ray powder diffraction and energy dispersive X-ray spectroscopy. The results reveal that the ZnSe nanowires are pure zinc-blende structure while the nanorings are mixed with both zinc-blende and wurtzite phases. Most of the nanowires have a diameter of few tens of nm and have a length up to 30 μm. The nanoring is in the form of a close-loop belt. The widths of the rings are in the range of 150-500 nm, the diameters are 3-7 μm and the thickness of 20-100 nm.

References:

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Figures:

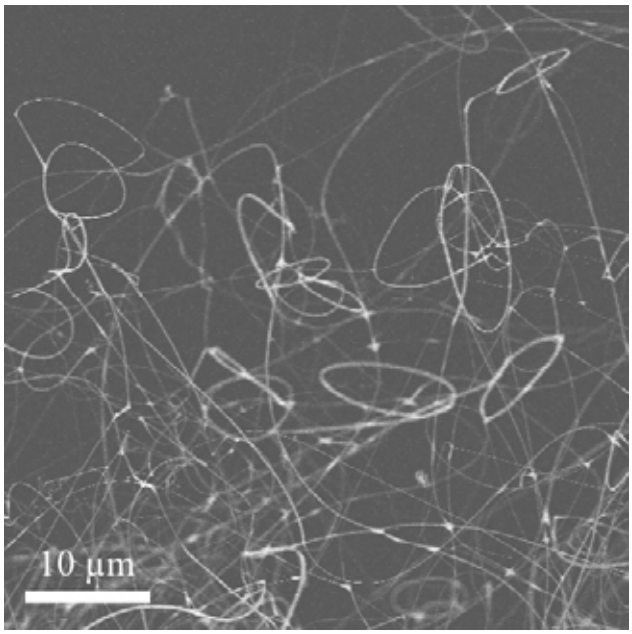

Fig. 1 – ZnSe nanorings

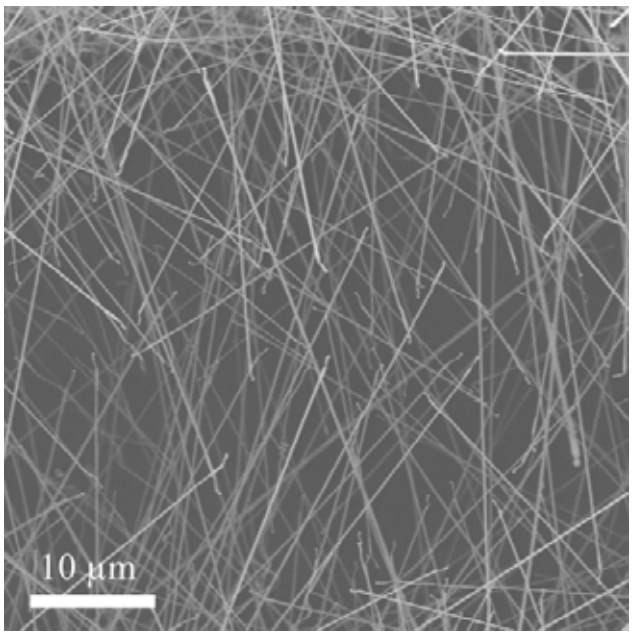

Fig. 2 – ZnSe nanowires