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Synthesis and Property of Nanostructured ZnS

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Nanostructured Materials are a new class of materials, having dimensions in the 1 to 100 nm range, which provide one of the greatest potentials for improving performance and extended capabilities of products in a number of industrial sectors. Zinc sulfide (ZnS), is one of the first semiconductors discovered and one of the most important materials in the electronics with a wide range of applications, including LEDs, electroluminescence, flat panel displays, infrared windows, sensors, lasers, and biology etc. The research on nanostructured ZnS have recently stimulated great interest due to their potential value for understanding fundamental physical concepts and for applications in constructing nanoscale electric and optoelectronic devices [1].

In this paper, the novel synthesis, property and potential application of nanostructured ZnS achieved in our group will be presented. Firstly, immaculately controlled growth of ZnS nanostructures in various sizes and shapes, including the first fabrication of hexagonal faceted ZnS single-crystal nanotubes, hierarchical ZnS multipod structures composed of ZnS nanowire arrays, nanostructured ZnS used as template for the fabrication of other nanotubes, novel various metal-ZnS heterostructures, Ga-doped ZnS nanowire-precursors for $ZnO/ZnGa_2O_4$ nanotubes and micrometer long quantum confined ZnS nanobelts etc, will be introduced briefly [2]. And then we will discuss our results on intrinsic properties of nanostructured ZnS, such as their optical property which was investigated by optical spectroscopy and high spatially resoled cathodoluminescence spectroscopy. For example, a new ultraviolet emission peak (~ 355 nm) was discovered within ZnS/ZnO biaxial nanobelt heterostructures (Fig .1) [3]. The electrical properties of single ZnS structures are also observed under in-situ TEM-STM. Finally, the potential applications by using the above-synthesized nanostructured ZnS will be presented. Such as, individual and multiple single-crystalline ZnS nanobelts with sharp ultraviolet (UV) emission at room temperature have been assembled as 'visible-blind' UV Sensors, especially in the UV-A region. The photoresponsivity of ZnS nanobelt-based UV sensors exhibited over three orders of magnitude gain under the UV light illumination as compared to a visible light (Fig .2) [4].

References

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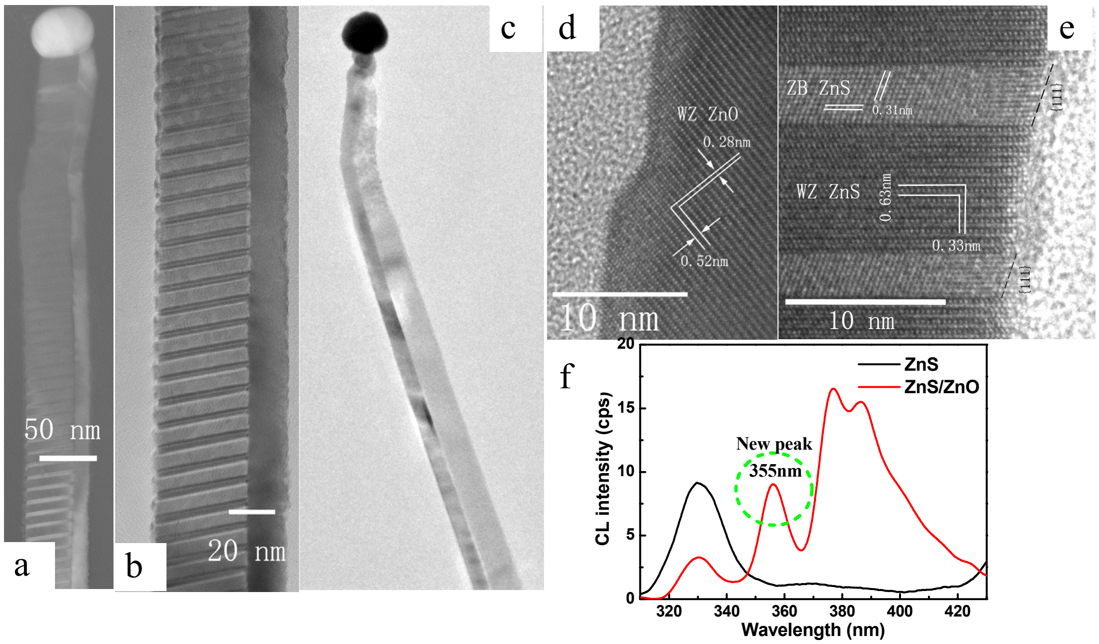

Fig. 1. The unique structure and cathodoluminescence of ZnS/ZnO biaxial nanobelt heterostructures[3]. (a)-(c). Typical TEM images of two novel ZnS/ZnO biaxial nanobelt heterostructures, (d) and (e). HRTEM images recorded from both sides of hetero-crystalline ZnS/ single-crystalline-ZnO biaxial nanobelts. (f). Representative CL spectra obtained at ~ 30 K from individual ZnS/ZnO biaxial nanobelts and pure ZnS nanobelts. A new ultraviolet emission peak (~ 355 nm) is observed for individual ZnS/ZnO biaxial nanobelts which is absent either in the pure 1D ZnS or ZnO nanostructures.

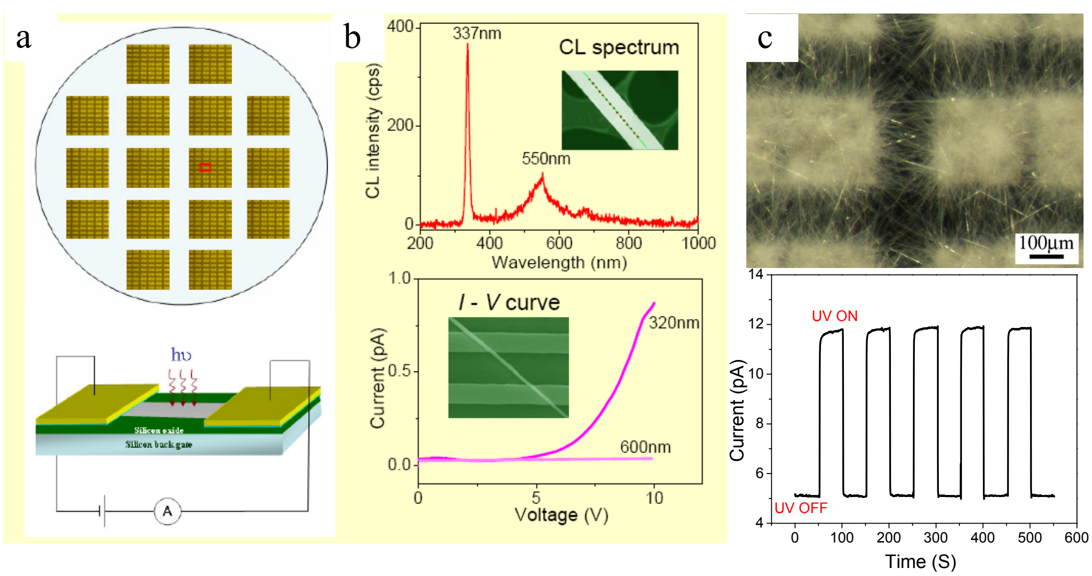

Fig. 2. Individual and multiple single-crystalline ZnS nanobelts with sharp ultraviolet (UV) emission (~ 337 nm) at room temperature have been assembled as UV Sensors[4]. The high spectral selectivity combined with high photosensitivity and fast time response justify the effective utilization of the present ZnS nanobelts as "visible-blind" UV photodetectors in different areas.

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