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Communication

Polyvinylpyrrolidone-assisted growth and optical properties of ZnO hexagonal bilayer disk-like microstructures

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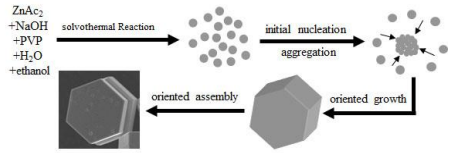
Graphical abstract



ZnO hexagonal bilayer disk-like microstructures are successfully prepared assisted with polyvinylpyrrolidone (PVP), and the photoluminescence (PL) spectrum of as-prepared ZnO samples showed a very strong ultraviolet (UV) emission at the UV region.

ABSTRACT
ZnO hexagonal bilayer disk-like microstructures are successfully fabricated using a simple solvothermal method assisted with polyvinylpyrrolidone (PVP). The structure and morphology were investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDX). XRD result indicated that the as-obtained samples were well-crystallized wurtzite hexagonal ZnO structure. SEM images showed that the ZnO hexagonal bilayer disk-like assembles consist of two uniform and smooth disks with an average edge length of 6 μm and thickness of ~4 μm. UV-vis spectrum reveals that ZnO sampls show an appreciable red shift and the band gap energy of the obtained ZnO samples were about 3.15 eV. A very strong ultraviolet (UV) emission at the UV region was observed in the photoluminescence (PL) spectrum of the as-prepared ZnO samples tested at room temperature. A possible growth process of the ZnO hexagonal bilayer disk-like microstructures was schematically illustrated.

Keywords:Semiconductor ZnO SynthesisStructural characterization Optical properties

Zinc oxide (ZnO) is an important semiconductor metal oxide with a wide direct band gap of 3.37 eV at room temperature [1]. It has stimulated great research interest over the past few years due to its unique properties that are useful for the fabrication of nanolasers, optoelectronic devices, and photocatalysts [2]. As is well-known, the physical and chemical properties of materials are strongly depended on their size, size distribution, structures, and dimensions. In our previous works, we reported the control synthesis of semiconductor metal oxide using different methods [3-11]. Controllable preparation of well crystallized and novel morphological ZnO micro/nanostructures is highly desired for many applications. Considerable effort has been devoted to the morphology-controllable synthesis of ZnO or ZnO-based microstructures [12-21]. For example, Qin *et al.* synthesized ZnO microstructures with hexagonal disk, prismoid, prism and pyramid *via* a facile two-step low temperature hydrothermal reaction [15]. Li and Wang prepared ZnO hierarchical microstructures with uniform flower-like morphology through a template- and surfactant-free aqueous solution route [16]. Cao *et al.* took advantage of a modified solvothermal route to achieve deliberate size modulation of ZnO nanorods [17]. Liu *et al.* synthesized 3D ZnO tubular flowerlike architectures and radial nanorods in the presence of polyethylene glycol [18]. Oh and co-workers prepared micrometer-sized ZnO hexagonal rings using the coordination-polymer template-directed approach [19]. Zhang *et al.* reported the shape-selective synthesis of ZnO particles with distinctive shapes by a novel polyvinylpyrrolidone-directed crystallization route [20]. Although many strategies have been developed to construct ZnO or ZnO-based microstructures, it is not easy to achieve good control of a ZnO structure with the desired crystal planes, morphologies, and microstructures. Thus, further research and designing new ZnO architectures through a facile aqueous solution route is necessary.