Novel Ga-doped, self-supported, independent aligned ZnO nanorods: one-pot hydrothermal synthesis and structurally enhanced photocatalytic performance

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Supporting Information

Experimental Section

The Ga-doped/self-supported aligned ZnO nanorods (GSAN) were prepared by the hydrothermal method. In a typical synthesis, 1.7 mmol of Ga was ultrasonically dispersed in 12.5 ml of ethanol for 1.5 hours. Subsequently, 4.4mmol of Stearic acid, 0.8mmol of Zinc stearate ($ZnSt_2$) and 7.5 mL of distilled water were added with stirring to form a uniform solution. Then the mixture was transferred into a Teflon-lined autoclave (30 ml), heated to 175 °C and maintained at this temperature for 10 hours. After the hydrothermal treatment, the white precipitates were collected and washed via filtration and redispersion cycles with each successive supernatant being decanted and replaced with heated ethanol, then dried in air for further characterizations.

The as-prepared products were directly subjected to scanning electron microscopy characterizations (SEM, FEI Quanta 200 FEG) attaching energy dispersive X-ray (EDX) spectroscopy, powder-X-ray diffraction (XRD, Philips PW-1830 X-ray diffractometer), and PL measurement (with a 325 nm He-Cd laser as the excitation source). For the transmission electron microscopic (TEM, JEOL 2010 microscopes operated at an accelerating voltage of 200 kV) observations, the as-prepared products were sonicated in ethanol for 20 min and the suspension was dropped onto a carbon-coated Cu grid, followed by evaporation of the solvent in the ambient environment. In addition, inductively coupled plasma-atomic emission spectrometry (ICP-AES) is also used to analyze Ga content in the composite materials.

The photocatalytic activity of the as-prepared products was evaluated by the photocatalytic decomposition of rhodamine B (RhB) aqueous solution at room temperature during irradiation with UV-visible light. UV-visible light was obtained by a 500W Xe lamp. The experimental details were as follows: 0.100 g of the as-prepared products was dispersed in 250 mL of 1.04×10^{-5} mol/L RhB aqueous solution in a beaker. Before irradiation, the suspensions were magnetically stirred in the dark for about 6 h to ensure the establishment of adsorption-desorption equilibrium of the dye on the catalyst surface. At given time intervals, 8 mL of reaction mixture was sampled and centrifuged to remove the as-prepared products. The concentration of RhB was determined by UV-vis spectrophotometer (Shimadzu UV-2550).

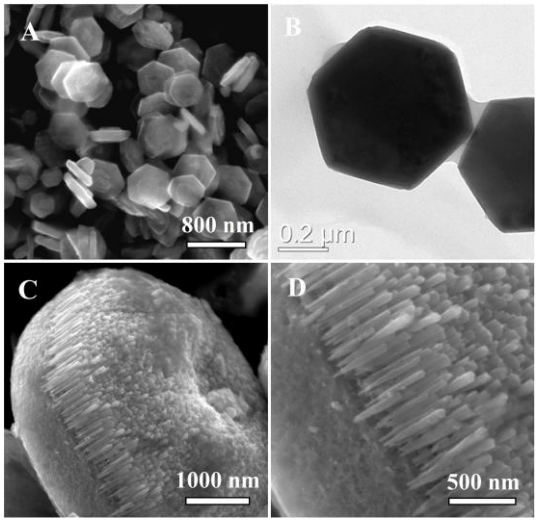

Fig. S1 ZnO hexagonal plates obtained under the same conditions in the absence of Ga. (A) A low magnification SEM image; (B) A higher magnification TEM image; The SEM images of the hybrid-structures obtained in case of excessive amount of Ga (C and D) .

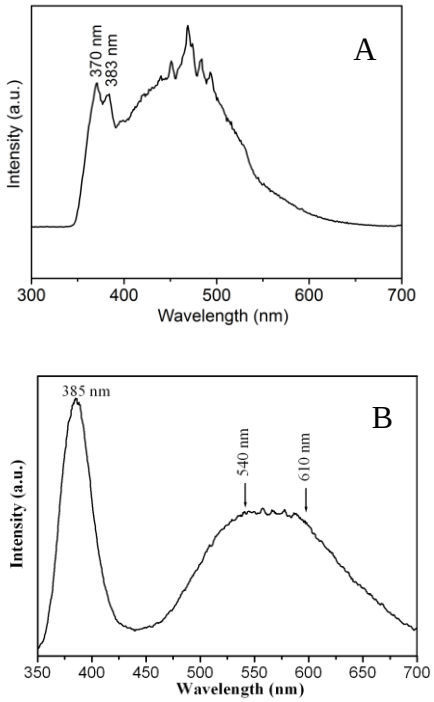

Fig. S2 PL spectra of the as-prepared products at room temperature (A) and ZnO hexagonal plates (B).