

Electronic Supporting Information

Ionic Liquid-Assisted Synthesis of Mesoporous α -Ga₂O₃ Hierarchical Structures with Enhanced Photocatalytic Activity

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Photocatalytic Reactions:

The photocatalytic activity of the as-prepared mesoporous α -Ga₂O₃ hierarchical structures was evaluated by the photocatalytic degradation of RhB aqueous solution at room temperature under UV light. A 300 W Hg arc lamp was used as a light source to provide the ultraviolet light. In a typical reaction, 50 mg of photocatalyst was dispersed into 50 mL of RhB aqueous solution (4 mg L⁻¹). At this time, 5 mL of mixed solution was taken out and denoted as 0 min in dark reaction. Before light irradiating, the suspension was stirred for 1 h in dark to reach adsorption equilibrium of RhB on the surface of photocatalyst. Then, the reaction was stopped at 20 min intervals and 5 mL of reaction solutions were extracted to determine the concentrations of the aqueous RhB solution by UV/vis spectroscopy. In this study, commercial α -Ga₂O₃ was used as a reference catalyst under the same condition. RhB aqueous solution without photocatalysts irradiated by UV light was used as a blank experiment.

Reuse of the photocatalyst:

Recycle experiment on photocatalytic decomposing of RhB was designed to examine the

recycling property of as-prepared photocatalysts. After finishing a cycle, the catalyst powders were separated from the reaction solution by centrifugation. After washing and drying, repetitive photocatalytic reactions began and the detail process was as same as the first cycle. The recycle experiment was carried out for five cycles.

Material characterization:

X-ray diffraction (XRD) patterns of the samples were recorded on a Bruker D8 Focus diffractometer (CuK α radiation, $\lambda=1.5418$ Å, 40 kV), field emission scanning electron microscopy (FESEM) measurement was performed by JSM-6700F instrument operated at an accelerating voltage of 10 kV, transmission electron microscope (TEM), high-resolution transmission electron microscope (HRTEM) and selected area electron diffraction (SAED) using Tecnai G2 instrument at an accelerating voltage of 200 kV, the FT-IR spectra of the samples were conducted at room temperature with a KBr pellet on a VECTOR-22 (Bruker) spectrometer ranging from 400 to 4000 cm^{-1} , ultraviolet visible spectrum thermogravimetric/differential scanning calorimetry (TG/DTG) was performed on SDT Q600 thermal analyzer under nitrogen with a heating rate of 10 $^{\circ}\text{C min}^{-1}$ from ambient temperature to 800 $^{\circ}\text{C}$, the Brunauer-Emmett-Teller (BET) specific surface area (S_{BET}) of the sample was analyzed by nitrogen adsorption in a Tristar 3000 nitrogen adsorption apparatus, UV spectra were recorded on a Cary 5000 spectrometer at room temperature.

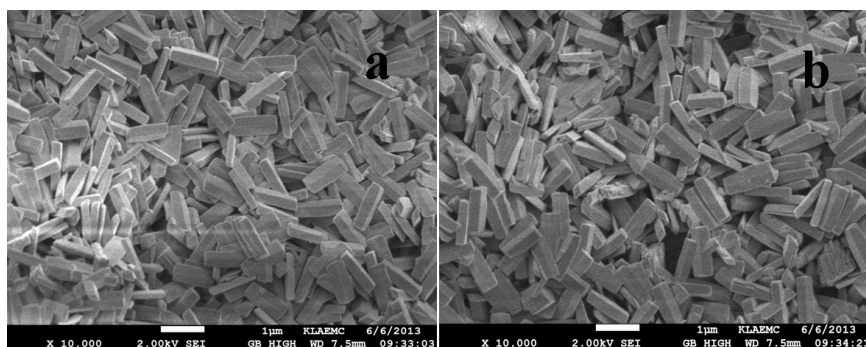


Figure S1 SEM images of samples (a) using NaOH instead of [Bmim][OH] and (b) using [Bmim][Cl] and NaOH instead of [Bmim][OH] to adjust the pH value as the [Bmim][OH] existence. Other parameters kept constant.

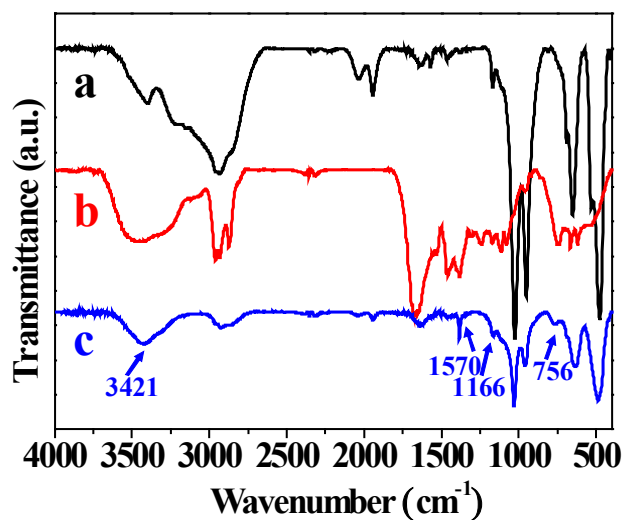


Figure S2 FT-IR spectra of (a) pure α -GaOOH, (b) pure α -GaOOH and (c) α -GaOOH/[Bmim][OH].

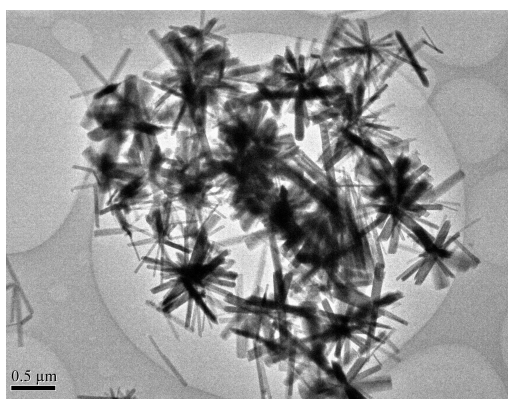


Figure S3 Low magnification TEM image of as-prepared mesoporous α -Ga₂O₃ hierarchical structures.

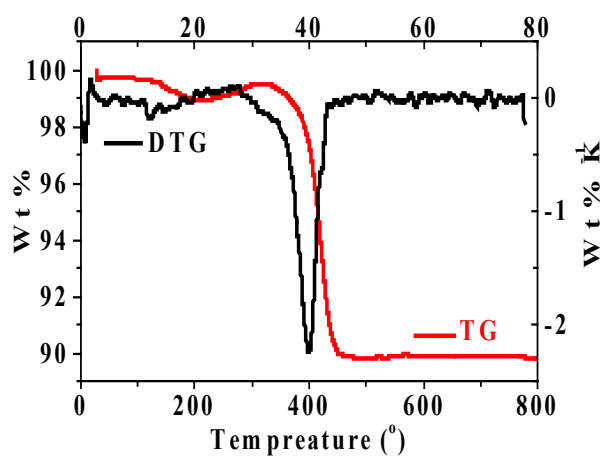


Figure S4 TG-DTG curve of the as-obtained α -GaOOH hierarchical structure. The sharper endothermic peak at around 450 °C, corresponding to about 10% of weight loss, should indicate the dehydration of GaOOH nanorods and the formation of α -Ga₂O₃.

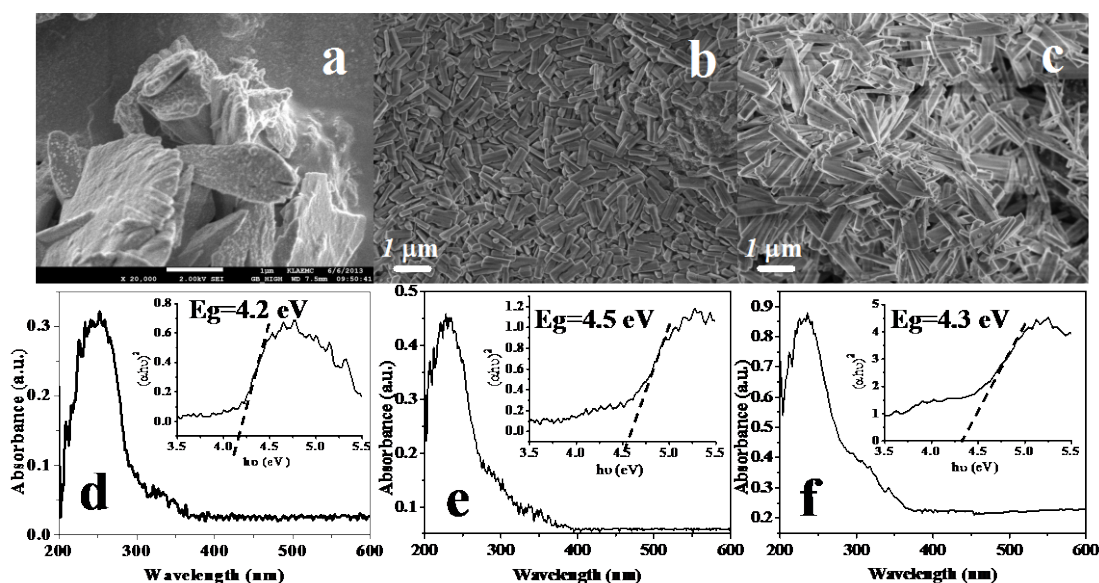


Figure S5 SEM images and ultraviolet-visible diffusive absorption spectra of the commercial α -Ga₂O₃, α -Ga₂O₃([Bmim][Cl]) and α -Ga₂O₃(NaOH), respectively. As shown in Figure S5a, commercial α -Ga₂O₃ exhibit bulk and irregular morphology with a large size. As shown in Figure S5b and S5c, the α -Ga₂O₃([Bmim][Cl]) and α -Ga₂O₃(NaOH) exhibit 1D nanorods-like with a lengths about 1 μ m and diameters about 300 nm, which is similar to the morphologies of α -GaOOH([Bmim][Cl]) and α -GaOOH(NaOH). The band gap energies of the commercial α -Ga₂O₃, α -Ga₂O₃([Bmim][Cl]) and α -Ga₂O₃(NaOH) estimated from the plot of transformed Kubelka-Munk function versus the energy of exciting light is about of 4.2, 4.3 and 4.5 eV, respectively.

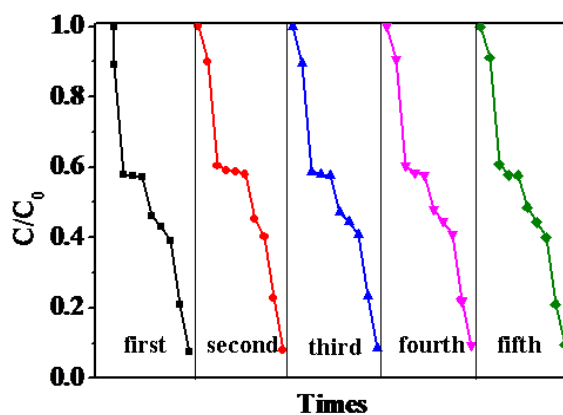


Figure S6 Degradation curves of RhB over as-prepared mesoporous α -Ga₂O₃ hierarchical structures reusing 5 times.