Electronic Supplementary Information

Phase transformation of ultrathin nanowires through lanthanide doping: from InOOH to rh-In_2O_3

Wen-Hui Zhang,[a] Feng Wang,[b] and Wei-De Zhang*,[a]

[a] School of Chemistry and Chemical Engineering, South China University of Technology, 381 Wushan Road, Guangzhou 510640, China

[b] *Department of Physics and Materials Science, City University of Hong Kong, 83 Tat Chee Avenue, Hong Kong SAR, China.*

Experimental details

Materials. Indium(III) chloride tetrahydrate ($InCl_3 \cdot 4H_2O$), gadolinium(III) chloride hydrate ($GdCl_3 \cdot xH_2O$), indium(III) acetylacetonate ($In(acac)_3$), gadolinium(III) acetylacetonate ($Gd(acac)_3$), oleylamine (OM, 70%) were purchased from Sigma-Aldrich and used as starting materials without further purification.

Synthesis of nanocrystals. The InOOH precursors were prepared by a solvothermal route firstly reported by Xu and Wang.[1] In a typical procedure, 0.1 g $InCl_3 \cdot 4H_2O$ and 0 g or 0.0065 g $GdCl_3 \cdot xH_2O$ (n_{Gd}/n_{In+Gd}=5%) was dissolved in 5 mL of OM. Then, 8 mL of ethanol was dropped in while ultrasonicating, forming a clear solution, which was transferred into a Teflon-lined stainless steel autoclave to react at 180 °C for 12 h. The product was collected at the bottom, washed three times with ethanol, and centrifuged at 5000 rpm for 2 min. The white product can be well redispersed in cyclohexane.

When the chlorides were replaced by acetylacetonates as raw materials, 0.1405 g $In(acac)_3$ and 0 g or 0.0082 g $Gd(acac)_3$ (n_{Gd}/n_{In+Gd}=5%) were used and other procedures were the same as described above. The Gd-doped product can be well redispersed in cyclohexane.

To transform InOOH to In_2O_3, the as-synthesized InOOH precursors redispersed in 1 ml cyclohexane was heated in 10 ml OM at 100 °C for 30 min, then degased at 100 °C for 30 min and subsequently heated at 250 or 300 °C for 30 min under Ar atmosphere. The product was washed three times with ethanol and collected by centrifugation at 5000 rpm for 2 min.

Characterization. JEM 1400 transmission electron microscope (TEM) operated at 120 kV was used to record TEM images of the samples. Scanning transmission electron microscopy (STEM) and high-resolution TEM (HRTEM) images were taken with FEI Tecnai F20 with an attached energy dispersed X-ray spectrometer (EDS). Powder X-ray diffraction (XRD) analyses were performed on a Philips PW-1830 X-ray diffractometer with Cu Kα irradiation (λ = 1.5406 Å) at a scanning speed of 0.014 degree/sec over the 2θ range of 10–70 degree. The photoluminescence (PL) spectroscopic measurements were performed on a LabRam HR spectrometer (JY-Horiba) with He-Cd laser as the excitation source (λ_{ex}= 325 nm).

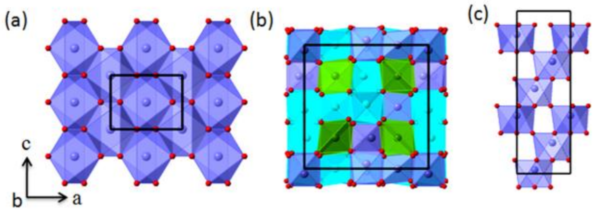

Figure S1 Crystal unit cell of (a) InOOH (H is not included for clarification), (b) c-In_2O_3 and (c) rh-In_2O_3 viewed along the b axes.

Reference

1 X. X. Xu and X. Wang, *Inorg. Chem.*, 2009, **48**, 3890.