Supporting Information

# Self-supported Helical Oxide Arrays Templated by Pore-swollen Chiral Mesoporous Silica

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## Experimental details

In a typical synthesis procedure, 0.5 g cetyltrimethylammonium bromide (CTAB, Alfa Aesar, >99.0 %) was dissolved in 150 g $H_2O$ at 296 K. Then 0.4 mL trimethylbenzene (TMB, Alfa Aesar, >98 % GC) was dropwised into the solution, and the mixture were stirred for 3 h. 0.45 g sodium silicate ($Na_2SiO_3 \cdot 9H_2O$) was dissolved and 0.29 mL ethyl acetate (EA, Alfa Aesar, >99.5 %) was then added under vigorous stirring. In 30 s, the solution was left to stand in a water bath at 296 K for 16 h. The product was isolated by centrifugation, and then washed thoroughly with deionized water. The organic templates were removed by microwave digestion (MWD), which was preformed on a model WX-4000 microwave sample preparation system. The maximum pressure and temperature were 1.0 MPa and 433 K. The amount of the mesoporous silica was approximately 0.167 g with 2 mL of 15 M $HNO_3$ and 1.3 mL $H_2O_2$ (30 %). The product was separated by centrifugation and then washed repeatedly with deionized water. For comparison, the as-synthesized mesoporous silica was calcined in air at 773 K for 6 h. Varying the added amount of TMB, mesoporous silicas with pore size of 2.0, 3.0 and 4.3 nm were synthesized, respectively. The amounts of TMB used for the fabrication of 2.0 and 3.0 nm pores are related to 0 and 0.27 mL.

The mesostructured metal oxides were prepared by two-step impregnation, using the swollen mesoporous silica as the hard template. 0.1g of chiral mesoporous silica was dispersed in 1 mL of 0.8 M $Co(NO_3)_2$ ethanolic solution, stirred at 298 K for 2 h, dried at 473 K for 10 h, re-impregnated and then calcinated at 723 K for 5 h. For the introduction of indium compound, 0.1g of chiral mesoporous silica was soaked in 0.8 mL of 0.8 M $In(NO_3)_3$ ethanolic solution for 2 h, dried at 353 K for 2h, re-impregnated and then calcined at 823 K for 5 h. 2 M NaOH aqueous solution was used to etch silica as template.

**Characterization**

Wide-angle powder XRD patterns were obtained on a Shimadzu XRD-6000 instrument with Cu Kα source, step size of 0.02°, and scan rate of 5 °/min. The XRD patterns from 2θ = 1° to 5° were taken on a Hitachi D/MAX-2500 instrument with Cu Kα source, and scan rate of 0.5 °/min. FT-IR spectra were recorded in air on a Bruker Vector 22 spectrometer (resolution 4 $cm^{-1}$) in the range of 4000-400 $cm^{-1}$, the samples being pressed into disks with KBr. The low-temperature $N_2$ adsorption-desorption experiments were carried out using a Quantachrome Autosorb-1 system. The sample was out-gassed at 473 K for 3 h before measurement. HRTEM and TEM images were conducted on a JEOL JEM-2010 electron microscope operating at 200 kV. The specimen was dispersed in ethanol using an ultrasonic washer, and dropped on a holey ultrathin carbon film. FESEM images were recorded with a Hitachi S4700 field-emission electron microscope. Diffuse reflectance spectra of the synthesized $In_2O_3$ in the range of 190-600 nm were recorded on a ThermoFisher Evolution 300 spectrophotometer. A Shimadzu RF-5301PC spectrophotometer was used to take photoluminescence spectra.

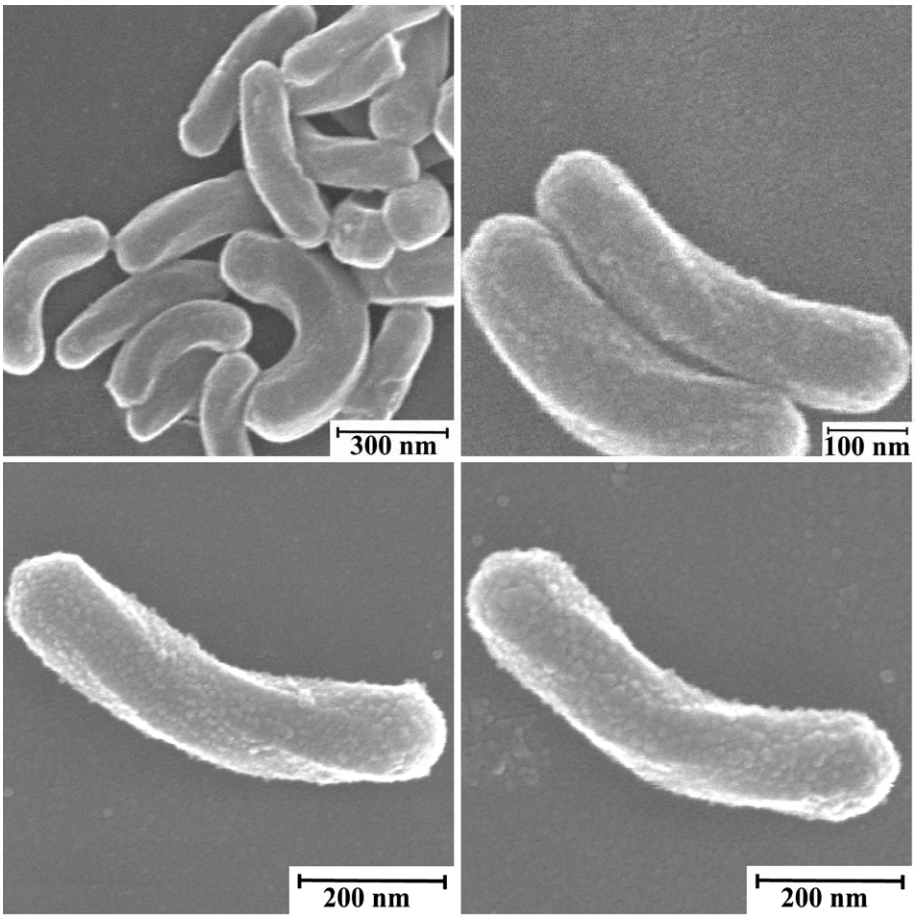


Figure S1. FESEM images of the helical mesoporous silica.

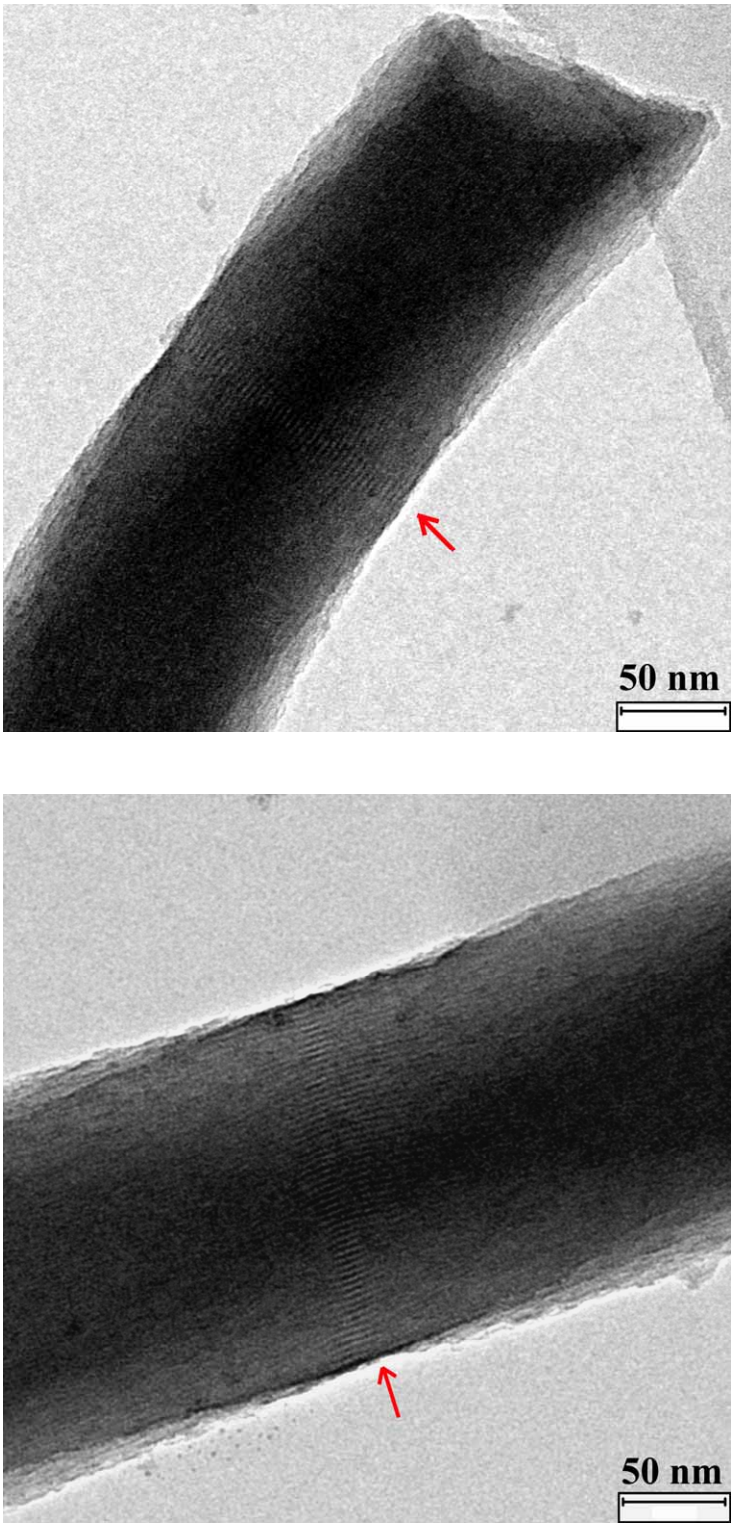


Figure S2. HRTEM images of the helical mesoporous silica.

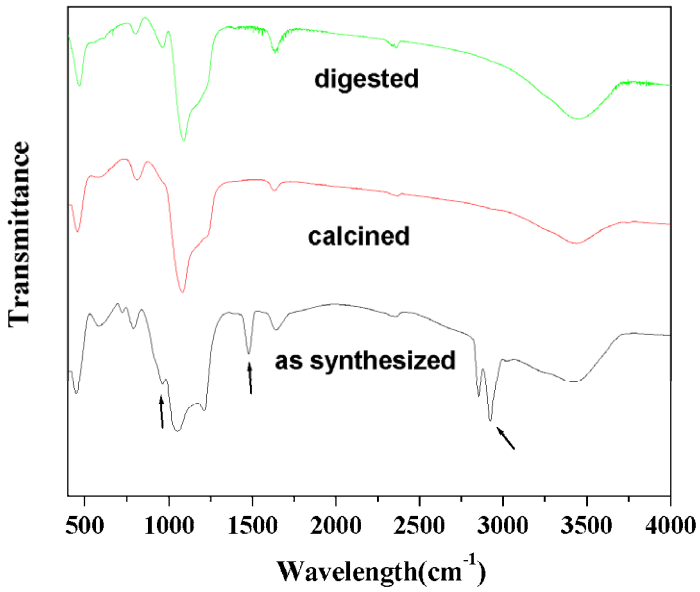


Figure S3. FT-IR spectra of as-synthesized, calcined and microwave digested swollen mesoporous slica materials. The absorption bands at around 2850-3000 and 1500 $cm^{-1}$ in the spectrum of the as-synthesized sample, assigned to C-H stretching and bending vibration of the template CTAB and TMB, are barely observed after calcination and microwave digestion. This indicates the two methods can both completely remove the organic species.

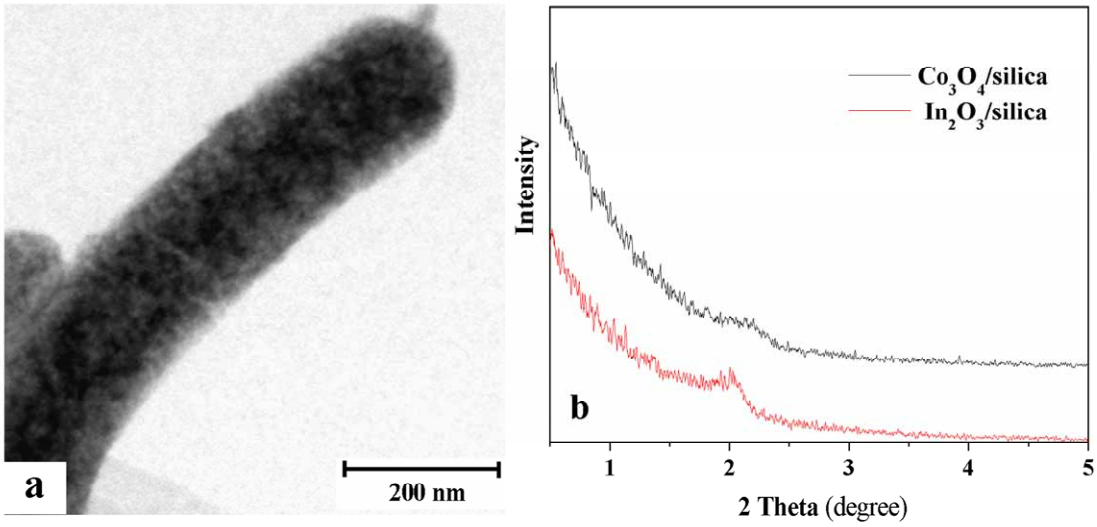


Figure S4. (a) TEM image of $In_2O_3$/silica composites, and (b) XRD patterns of the $Co_3O_4$/silica and $In_2O_3$/silica compositions.