

## Experimental Section

### Materials

Hydroperoxide (30%) and other reagents were all obtained from commercial sources without any further purification.

### Preparation of SIHP

Aqueous solutions of ferric nitrate were made by dissolving  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  and  $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$  (the mole ratio was 1:1) in deionized water. Then a certain of cetyl trimethyl ammonium bromide (CTAB), poly(oxyethylene)<sub>10</sub>nonylphenol ether (NP-10) and butanol were added to cyclohexane to make the organic phase, aqueous solution and organic phase were mixed according to the volume ratio 1:5. the pH of the emulsion was adjusted to 10 by adding 4 mol/L NaOH solution with continuous stirring, and the emulsion was aged at 200 °C for 48 h. The mixture was centrifuged and washed with absolute ethanol and water. After drying overnight in a vacuum oven at 80 °C, the product was calcined at 500 °C for 4 h to obtain brown powders.

### Preparation of Au/SIHP catalyst

Au/SIHP catalysts were prepared by DP with urea, in the so-called standard preparation procedures: 0.5 g sodium iron (III) hydroxyphosphate was added into 20 ml of an aqueous  $\text{HAuCl}_4$  solution ( $3.0 \times 10^{-3}$  M) and 0.37 g urea ( $3 \times 10^{-1}$  M). The initial pH was about 2. The suspension thermostated at 80 °C, was vigorously stirred for 8 h (pH increases) and then centrifuged, washed and dried (Au content: 3.0 wt%). Other materials supported gold catalyst, such as Au/ $\text{Fe}_2\text{O}_3$ , Au/ $\text{Fe}(\text{OH})_3$ , and Au/ $\text{FePO}_4$ , were prepared under the same conditions.

### Catalyst characterization

The morphologies of obtained Au/SIHP catalysts were examined by transmission electron microscope (HRTEM) (JEM-2010) and scanning electron microscopy (SEM) (JSM-7600F). The crystal of the catalysts was studied by X-ray diffraction (XRD) (X' Pert PRO PANalytical). Surface composition was determined by X-ray photoelectron spectroscopy (XPS), using a K-Alpha-surface Analysis system with X-Ray Monochromatisation. The diffuse reflectance UV–vis spectra were recorded with an UV–vis Jasco V550 diffuse reflectance spectrophotometer in the 250–800 nm range. The fourier transformed-infrared spectroscopy (FT-IR) spectra of samples were obtained on a Bruker Tensor 27 spectrometer. Specific surface area was measured by  $\text{N}_2$  adsorption-desorption isothermals at 77 k over an ASAP 2010 instrument. The inductively coupled plasma optical emission spectroscopy

(ICPOES) analyses were carried out using a Varian ICP-OES 720ES apparatus.

### **Catalyst test**

Catalytic reactions were carried out according to the following procedure: A mixture of 0.02 g catalyst, 8 mmol sulfides and solvents was stirred in a 100 ml round-bottom flask equipped with a condenser at room temperature for 5 min, after the addition of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), the reaction was started by immersing the flask in the oil bath kept at the reaction temperature, then carried out with vigorous stirring for a certain time. The products were analysed by gas chromatography (GC 9560) with a DB-1 capillary column.