Electronic Supplementary Material (ESI) for Energy and Environmental Science

Supporting Information

Hydrolysis of Biomass by Magnetic Solid Acid

Catalysts Characterization

X-ray powder diffraction (XRD) data were acquired on a JEOL-2010 diffractometer using Cu Kα radiation at both small-angle and large-angle.

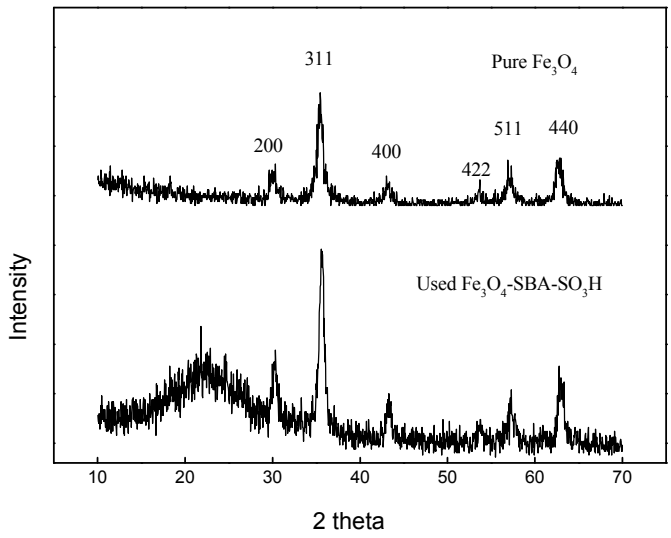

Figure S1. XRD patterns of Fe_3O_4-SBA-SO_3H after reaction.

Transmission electron microscopy (TEM) microphotographs were performed on a X′ PERT PRO electron microscope operating at 200 kV.

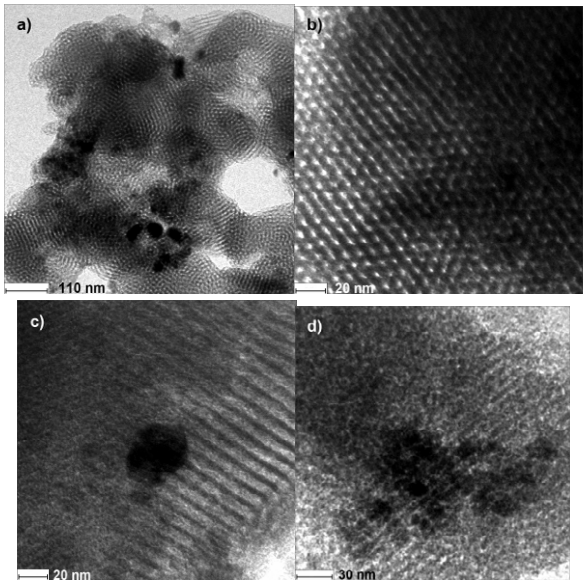

Figure S2. TEM images of fresh (a, b and c) and used (d) Fe_3O_4-SBA-SO_3H catalysts.

X-ray photoelectron spectroscopy (XPS) analysis was carried out on a Thermo Scientific Escalab 250 instrument using Al Kα source to excite the photoelectrons from the samples. For energy calibration, the C1s was assigned to be 284.8 eV. The XPS spectrum of sulphur element exhibits only one peak (169.01 eV) between 158 ~ 177 eV in binding energy in catalyst.

The amount of acid sites was determined by inductively coupled plasma atomic emission spectroscopy (ICP-AES, Thermo-Jarrell ASH-Atom Scan Advantage) based on the sulphur content.

Activity test

Cellobiose and microcrystalline cellulose (crystallinity ≈ 75 % based on characteristic peak of cellulose in XRD pattern) were purchased from Alading Co. Ltd.. The amorphous cellulose was prepared by dissolving microcrystalline cellulose into 1-butyl-3-methylimidazolium chloride at 80 °C and precipitating it from water.[1,2] The XRD patterns of microcrystalline cellulose and amorphous cellulose was shown in Figure S4. The degree of cellulose crystallinity was calculated by the formula: Crystallity = $I_{cr}/(I_{cr}+I_{am}) \times 100\%$. Where I_{cr} and I_{am} are the peak intensities from crystalline and amorphous regions of cellulose, respectively. Carbohydrate materials were dried at 80 °C under vacuum before use.

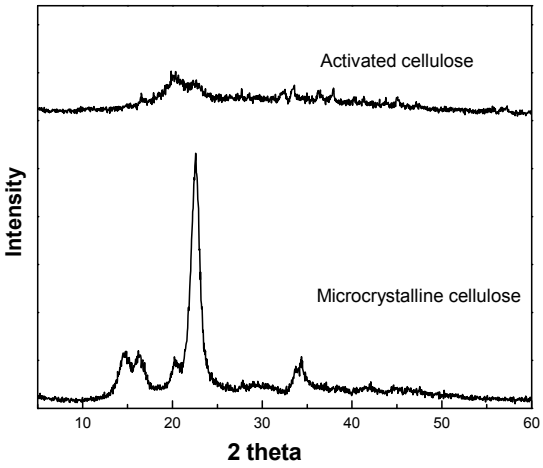

Figure S3. XRD patterns of microcrystalline cellulose and amorphous cellulose.

The concentration of glucose were analyzed by a HPLC system consisting of a Waters 1525 pump, a Waters $5C_{18}$-PAQ column (4.6×250 mm) or a D-Sugar column and a Waters 2414 refractive index detector. H_2SO_4 (5 mM) was used to mobile phase at flow rate of 0.6 mL min^{-1}. The amount of total reducing sugars was determined by reaction with 3, 5-dinitrosalicylic acid (DNS) at 373 K. The color formation was monitored at 510 nm using a Shimazu DUV-3700 spectrometer. The quantification was carried out by external standard method.

[1] R. P. Swatloski, S. K. Spear, J. D. Holbrey, R. D. Rogers, *Journal of the American Chemical Society* **2002**, *124*, 4974.
[2] H. Zhao, C. I. L. Jones, G. A. Baker, S. Xia, O. Olubajo, V. N. Person, *Journal of Biotechnology* **2009**, *139*, 47.