Supporting Information

Moderation of Textural Properties in Hierarchical ZSM–5 to Enhance Yield of Olefins in Catalytic Cracking of Hydrocarbons

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1. Materials

Aluminum isopropoxide (AIP, ≥98.0% pure) was purchased from Shanghai Aladdin Biochemical Technology Co, Ltd (Shanghai, China). Tetrabutylphosphonium hydroxide (TBPOH, 40 wt% in H_2O) and tetrabutylphosphorus hydroxide (TPAOH, 25 wt% in H_2O) were purchased from Toshii Kasei Industrial Development company (Shanghai,China). Tetraethylorthosilicate (TEOS, ≥ 98% pure) and *n*-pentane (≥ 99% pure) were purchased from Kermel Chemical Reagent company (Tianjin, China.). NaOH (≥ 99.0% pure) was purchased from Tianjin Deen Chemical Reagent company. Aluminum sulfate ($Al_2(SO_4)_3 \cdot 18H_2O$,≥ 99% pure) was purchased from Tianjin Guangfu Science and Technology Development company(Tianjin ,China).

2. Characterizations

X–ray diffraction (XRD) detections were carried out by a Philips X'Pert MPD diffractometer with Cu–Kα radiation source (0.154 nm). The surface morphology of zeolites was observed through a FEI scanning electron microscopy (SEM, Nova NanoSEM 450). The transmission electron microscopy (TEM) images was acquired using an JEOL electron microscope (JEM–F200). Elemental analysis characterization was quantified by an inductively coupled plasma–optical emission spectroscopy (ICP–OES, Optima 2100DV). N_2 adsorption−desorption measurements were conducted at on an Autosorb–iQ2–MP (Quantachrome Instruments).

All the chemisorption detections were performed on AMI–300 (Altamira Instruments) instrument. In ammonia temperature–programmed desorption (NH_3–TPD), 50 mg of sample was treated in a flow of He to remove any physiosorbed NH_3 and then the temperature was raised to 600 °C at a rate of 10 °C/min to obtain any chemically adsorbed NH_3. Infrared spectroscopy (IR) was performed using a Bruker VERTEX 70 spectrometer. Each spectrum was recorded with 64 scans with a resolution of 4 cm^{-1}. In pyridine–adsorbed IR (Py–IR) spectroscopy detection, each sample was pressed into a self–supported wafer and activated at 400 °C for 1 h under high vacuum. The adsorption of pyridine was performed at 50 °C, and the spectrums were collected at 200 °C

Calculation of TOF values

The turnover frequency (TOF) of *n*–pentane conversion is determined as:

$$TOF = \frac{X \times WHSV}{T_{BAS} \times M_{n-pentane}}$$

Where X (%) is the conversion of *n*–pentane. *WHSV* is the weight hourly space velocity of the reaction. T_{BAS} ($\mu mol \cdot NH_3 \cdot g^{-1}$) is the total amount of Brønsted acidities. And $M_{n\text{–pentane}}$ ($g \cdot mol^{-1}$) is molar mass of *n*–pentane. We have revised the manuscript.