Supplementary Information

In-Situ Catalytic Fast Pyrolysis of Pinecone over HY Catalysts

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Preparation of Ni/HY(30): 1 wt% Ni was impregnated on HY(30) using $Ni(NO_3)_2$. After impregnation, Ni/HY was calcined at 550 °C for 1hr.

NH3 TPD analysis: For the temperature-programmed desorption of ammonia (NH_3-TPD), a BEL-CAT-B device manufactured by BEL JAPAN was used to analyze the acid strength in the catalyst and the number of acid sites. Prior to the NH_3-TPD analysis, outgassing of the sample was conducted under a helium flow (50 ml/min) at 550 °C for one hour. After the adsorption of ammonia for 30 min at 100 °C, physically adsorbed ammonia was removed by flowing helium for 2 h. Temperature-programmed desorption of ammonia was then carried out from 100 °C to 550 °C at a heating rate of 10 °C min^{-1} under a flow of He gas. The desorbed NH_3 was monitored with a thermal conductivity detector. In order to analyze the types of acid sites over the catalysts, the FT-IR spectra of the adsorbed pyridine were obtained with a Spectrum GX tool equipped with a MCT detector (Perkin Elmer) and an in situ cell containing CaF_2 windows. After degassing of the disk-type catalyst (0.013 g) for 2 h in a vacuum below 1.0×10^{-2} torr and at 350 °C, pyridine was allowed to absorb onto the catalyst for 30 min at room temperature. The IR spectrum was collected in a temperature range of room temperature to 300 °C under a vacuum below 1.0×10^{-2} torr.

Py-GC/MS: The sample (pine cone or pine cone/HY mixture) was free-fallen to the pyrolyzer heater preheated at 500 °C or 600 °C. The product vapor emitted from the pyrolysis heater was transferred to a deactivated metal capillary column (UA-5, 30 m length x 0.25 mm inner diameter x 0.25 ㎛ inner

diameter) via GC split/splitless inlet (320 ^{o}C, split ratio 200:1) and cryo-focused at the front part of the column using liquid nitrogen (-193 ^{o}C). After 3 minutes cryo-focusing time, the products was separated in the column by applying GC over temperature program, 40 ^{o}C (3 minute hold) for 320 ^{o}C (5 minutes hold) at 20 ^{o}C/min, and detected in a mass spectroscopy (EI mode, scan range 19 ~ 550). The identification of each peak on the total ion chromatogram was performed by comparing the mass spectrum of each peak with NIST 08th or F-Search library..