

Supplementary Information

Multi-walled carbon nanotubes-supported acidic ionic liquid catalyst for the conversion of biomass-derived saccharides to 5-hydroxymethylfurfural

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Materials and methods

All reagents and solvents were obtained from Sigma-Aldrich and Merck companies and were used as received.

Fourier transform infrared (FTIR) spectra were recorded on a Shimadzu FT-IR-8300 spectrophotometer using KBr windows. A Mettler TGA 851 instrument was used for the Thermogravimetric (TG) analysis. Energy dispersive X-ray (EDX) analysis was carried out using a FE-SEM instrument (TESCAN-Vega 3). N₂ physical adsorption was carried out on Belsorp-mini (II) gas analyzer (before the measurements, samples were degassed at 120 °C for 4 h). The specific surface area was evaluated from the (Brunauer–Emmett–Teller) BET equation. X-ray diffraction (XRD) patterns were measured on a Panalytical X Pert-Pro using Cu-K α radiation as the X-ray source. Transmission electron microscopy (TEM) measurement was performed using a Zeiss-EM10C instrument operated at 200 kV. The progress of the reaction was monitored by thin layer chromatography (TLC) using silica gel SIL G/UV254 plates. ¹H and ¹³C NMR spectra were recorded on a Bruker Avance DRX-400 MHz spectrometer using CDCl₃ as the solvent. High-performance liquid chromatography (HPLC) analysis of HMF was recorded on a HPLC instrument (Agilent Technology Model: 1260 equipped with a UV-vis detector connected to eclipse XDB-C18), in which the mobile phase was a methanol:water (2:8) mixture with a flow rate of 1 mL min⁻¹ and the column and UV-vis detector temperatures were maintained at 30 °C and 35 °C, respectively.

The acid capacity of the catalyst was calculated by acid-base titration using NaCl solution as an ion-exchange agent. In a typical procedure, 0.05 g of the catalyst was suspended in 15 mL of aqueous NaCl saturated solution. The resulting suspension was stirred at room temperature for at least 24 h, followed by filtration and washing with 30 mL of deionized water. The filtrate was then

titrated with 0.01 M NaOH solution. in the presence of phenolphthalein as indicator. The reported titration result was average values of three independent titrations, which was calculated with the following formula:

$$C(\text{SO}_3\text{H}) = C(\text{NaOH}) \times V(\text{consume, NaOH})/m(\text{SO}_3\text{H}@ImIL@MWCNTs)$$

Elemental analysis of the catalyst

Table S1. Elemental analysis results or the catalyst.

Sample	C (%)	H (%)	N (%)	S (%)
SO ₃ H@ImIL@MWCNTs	87%	2.68	3.43	4.05

Characterization of HMF

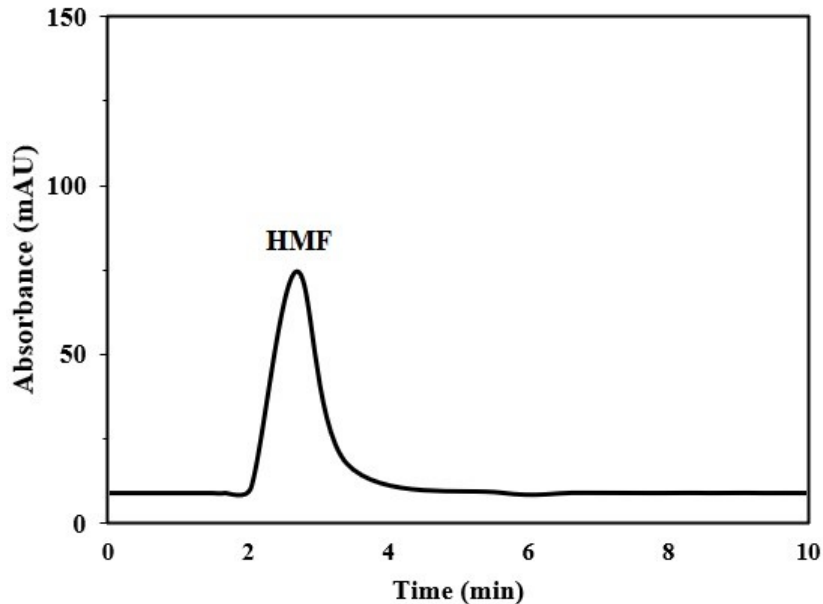


Fig. S1. HPLC analysis result of the isolated HMF.

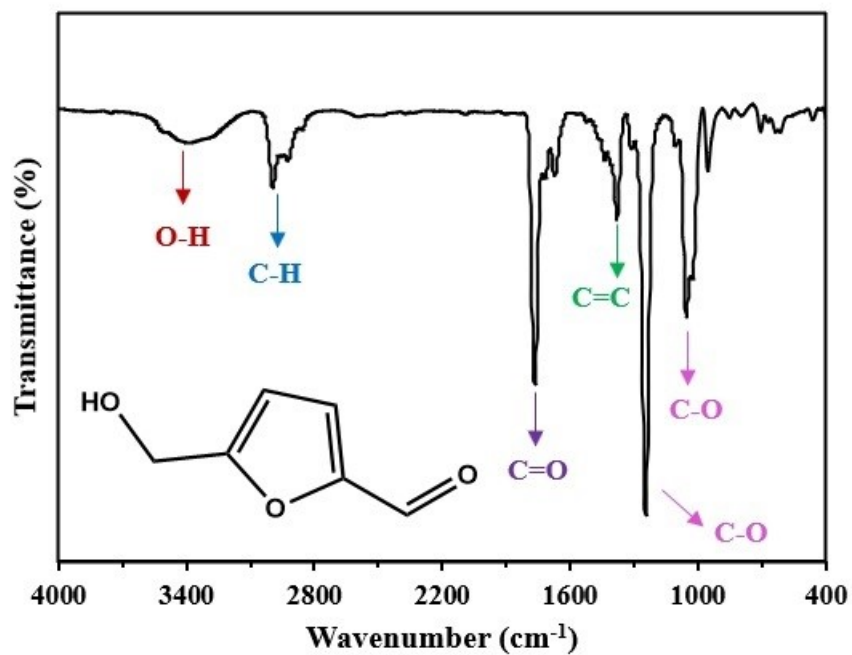


Fig. S2. FT-IR spectrum of the isolated HMF.

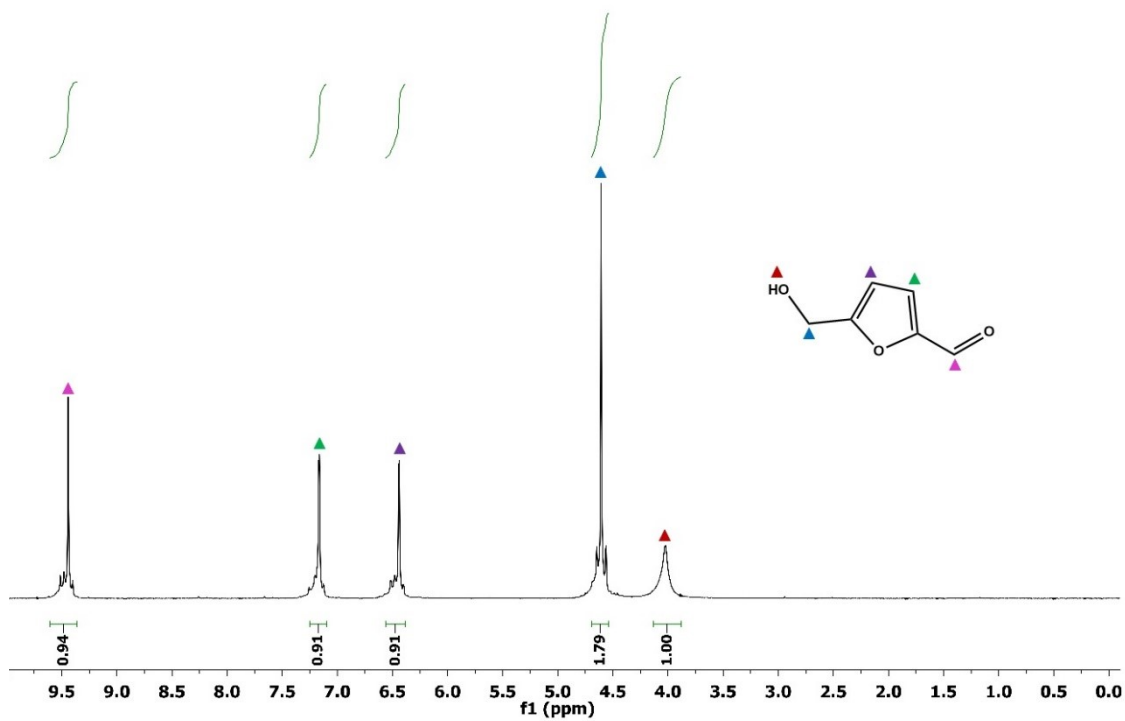


Fig. S3. ¹H NMR spectrum of the isolated HMF in CDCl₃.

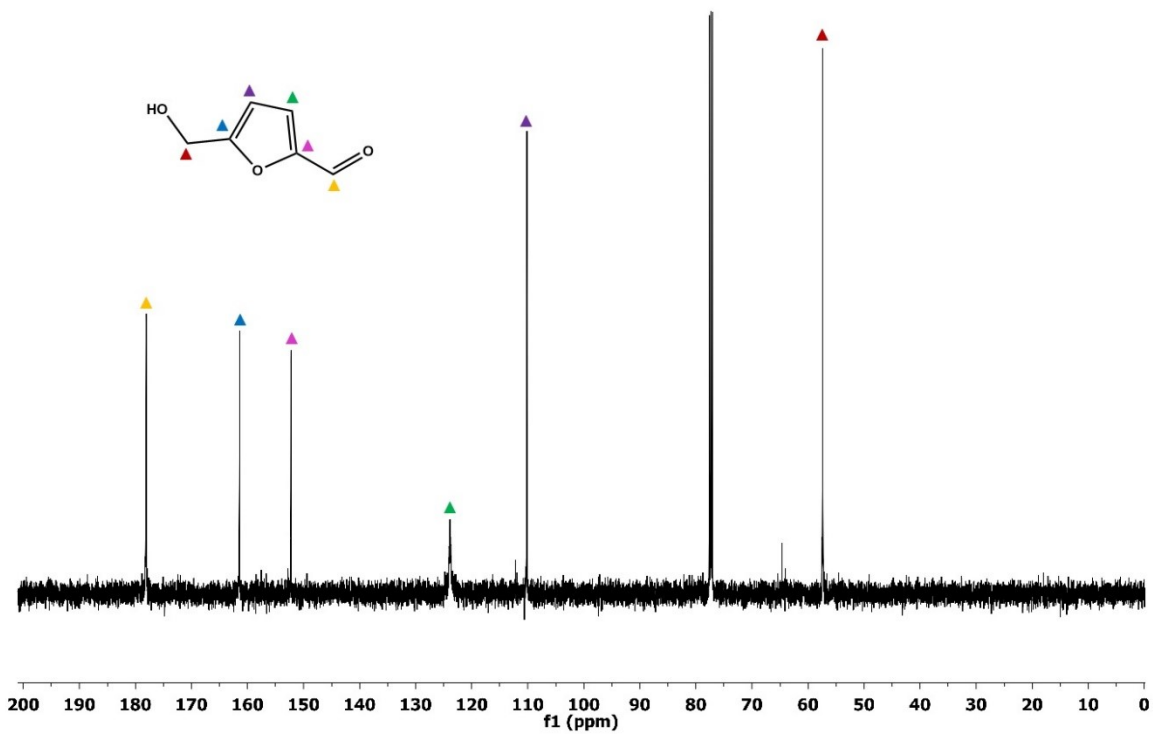


Fig. S4. ¹³C NMR spectrum of the isolated HMF in CDCl₃.