

Electronic Supplementary Information (ESI)

Surface acoustic waves (SAWs)-induced synthesis of HKUST-1 crystals with different morphologies and sizes

Chaoping Xu,^{a,b} Chaohui Wang,^{*a,b} Tengfei Zheng,^{a,b} Qiao Hu,^{a,b} and Cheng Bai^{a,b}

^a State Key Laboratory for Manufacturing Systems Engineering, Xi'an Jiaotong University, Xi'an 710049, People's Republic of China

^b Shaanxi Key Laboratory of Intelligent Robots, Xi'an Jiaotong University, Xi'an 710049, People's Republic of China

E-mail: chhw@mail.xjtu.edu.cn

Experimental procedure

Materials

The lithium niobate (LN) piezoelectric substrate (2 inches diameter and 1 mm thick wafer) was purchased from Shanghai Institute of Optics and Fine Mechanics, the Chinese Academy of Sciences, China. All chemicals and solvents were purchased commercially available. Copper (II) nitrate trihydrate and benzene-1,3,5-tricarboxylic acid were purchased from Aldrich Chemical Co. Inc., Wisconsin, USA. The solvents including N,N-dimethylformamide, anhydrous ethanol and acetone were purchased from Sinopharm Chemical Reagent Co., Ltd., Shanghai, China. The deionized water was obtained from Millipore MilliQ Academic system.

Synthesis of HKUST-1 crystals

In a typical experiment, 0.46 g copper (II) nitrate trihydrate (0.09 M) was dissolved in 21 mL mixture of 7 mL N,N-dimethylformamide, 7 mL ethanol and 7 mL deionized water (1:1:1, v/v). Similarly, 0.26 g benzene-1,3,5-tricarboxylic acid (0.06 M) was dissolved in the same solvent. The solvothermal synthesis of HKUST was in a 75 °C oven. The experiments of control without SAWs and experiments with SAWs were under the same conditions. SAWs introduced synthesis was on a 75 °C hot plate. When the SAWs device had heated to 75 °C, a 20 µL droplet of the benzene-1,3,5-tricarboxylic acid solution was pipetted onto the LN substrate between the IDTs. Followed 20 µL droplet of the copper (II) nitrate trihydrate solution was quickly pipetted onto the same position.

Synthesis of Zn-HKUST-1 crystals

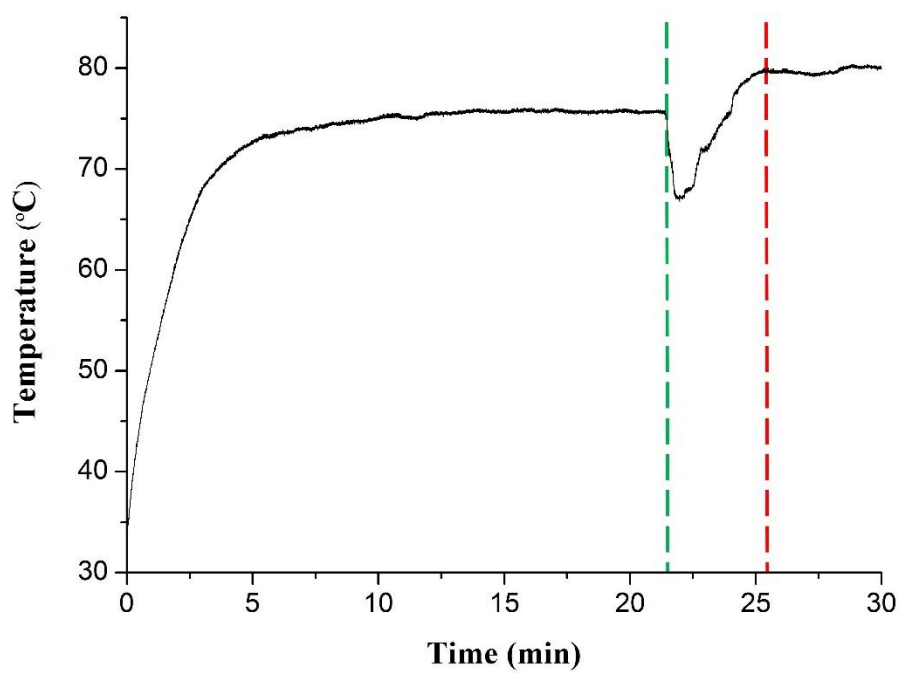
In a typical experiment, 0.48 g zinc (II) nitrate hexahydrate (0.09 M) was dissolved in 18 mL mixture of 6 mL N,N-dimethylformamide, 6 mL ethanol and 6 mL deionized water (1:1:1, v/v). Similarly, 0.22 g benzene-1,3,5-tricarboxylic acid (0.06 M) was dissolved in the same solvent. The solvothermal synthesis of HKUST was in a 75 °C oven. The experiments of control without SAWs and experiments with SAWs were under the same conditions. SAWs introduced synthesis was on a 75 °C hot plate. When the SAWs device had heated to 75 °C, a 20 µL droplet of the benzene-1,3,5-tricarboxylic acid solution was pipetted onto the LN substrate between the IDTs. Followed 20 µL droplet of the zinc (II) nitrate hexahydrate solution was quickly pipetted onto the same position.

Powder X-ray Diffraction Experiments

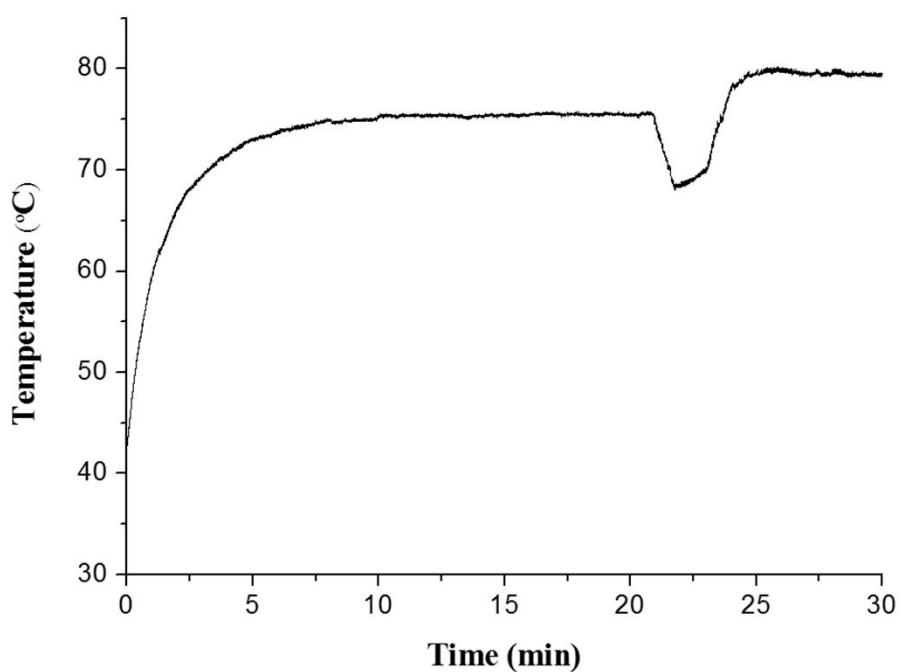
PXRD data were obtained from products *in situ* on SAWs device by a Bruker D8 Advance X-ray diffractometer (Germany) using CuK α radiation at 40 kV and 40 mA with $\lambda = 1.5418 \text{ \AA}$. Diffracted signal was detected by a LynxEye PSD detector. The widths of incident and receiving slit are set 1 mm and 5 mm, respectively. Both the incident and detection end of the X-ray tube are installed the soller slit 2.5 °. (scan type: coupled 2 θ / θ ; scan mode: continuous PSD fast; step size: 0.02 °)

Scanning Electron Microscopy Experiments

Products removed from SAW devices were directly placed on a coverslip with conductive adhesive for analysis. The sample was coated *in vacuo* with gold (Emitech K575X turbo sputter coater, 35 mA, 60 s). All samples were analyzed using a Zeiss Gemini SEM 500 (Germany) scanning electron microscope employing accelerating voltages of 5.0 kV-10.0 kV.



(a)



(b)

Fig. S1 (a) The temperature curve of the SAWs device recorded by the infrared camera. The green line represents the time at which the reaction solution was added dropwise, while the red line represents the termination of the reaction. This reaction time varies depending on the output power of SAWs, usually 2-4

minutes. (b) The temperature curve without the SAWs device recorded by the infrared camera.

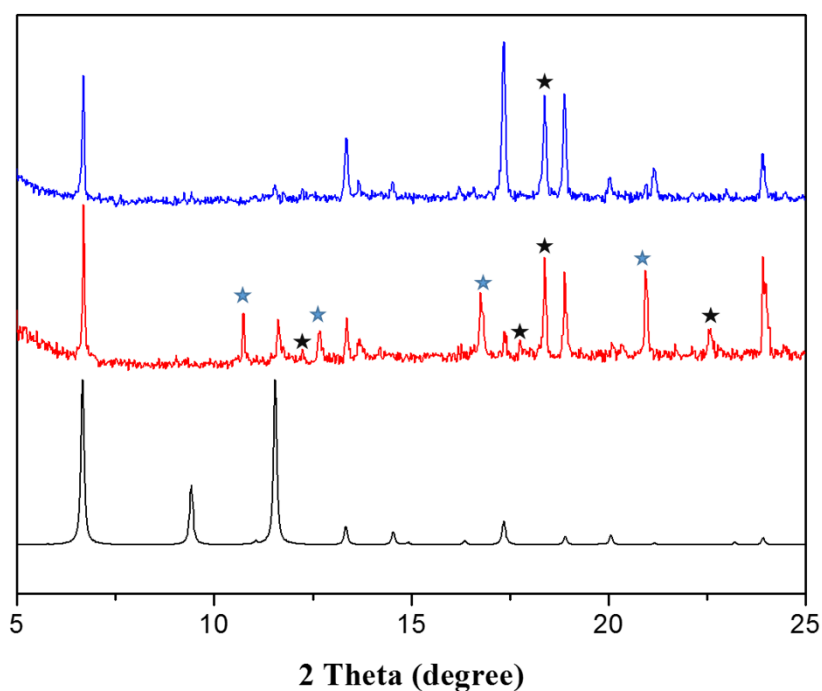


Fig. S2 PXRD patterns of simulated Zn-HKUST-1, samples prepared by control without SAWs and the SAWs-induced synthesis. Black line is simulated, red line is control without SAWs, blue line is the SAWs-induced synthesis. Black star marks the peak of zinc (II) nitrate hexahydrate, and blue star marks the peak of trimesic acid.

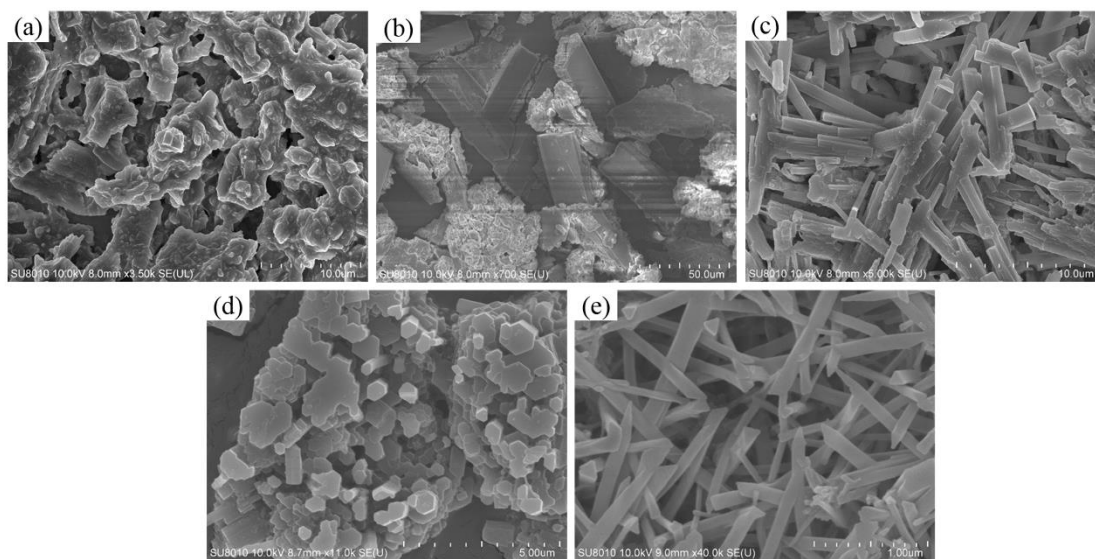


Fig. S3 The SEM images of Zn-HKUST-1 samples prepared by SAWs-induced synthesis with different input powers: (a) 0V (control without SAWs); (b) 5 V; (c) 10 V; (d) 15 V; (e) 20 V.