Supporting Information

Hetero-Metal HydroxideNanostrand Assisted Synthesis of MIL-110 Nanorod Arrays on Porous Substrate

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1. Experimental Section:

Materials: Copper nitrate (Cu(NO₃)₂·3H₂O), zinc nitrate (Zn(NO₃)₂·6H₂O), cadmium nitrate (Cd(NO₃)₂·4H₂O), aluminium nitrate (Al(NO₃)₃·9H₂O), 2-aminoethanol (NH₂-CH₂CH₂OH), were purchased from Acros Chemicals. 1,3,5-benzenetricarboxylic acid (trimesic acid, H₃BTC) was purchased from Sigma-Aldrich. The supports were porous Anopore alumina membranes (Whatman) with an average pore size of ca.200 nm. Ultrapure water of 18.2 MΩ produced by a Millipore direct-Q system was used throughout the experiments.

MIL-110 nanorod arrays synthesis: Typically, the MIL-110 nanorod arrays were prepared including the formation of CHNs mesoporous thin films by filtering 15, 30 and 60 ml CHNs solution on a porous alumina membrane surface with effective area of 2.83 cm², respectively. The obtained CHNs thin films were then placed face-up on the bottom of an autoclave with 30 ml, 1 mM H₃BTC deionized water solution and heated at 120°C for 3, 6, 9 and 24 h. After that, the autoclave was cooled to room temperature with a cooling rate of 10°C·h⁻¹. The obtained samples were washed with abundant deionized water for several times and then treated at 40°C in an oven to prevent the appearance of cracks caused by the release of interface stress.¹

Characterization: The phases of the as-prepared products were characterized by XRD at room temperature using an X’Pert PRO (PANalytical, Netherlands) instrument with...
Cu Kα radiation. The morphologies and structures were characterized by using scanning electronic microscopy (SEM) (Hitachi S-4800), and TEM (Tecnai G2 F20 S-TWIN). SEM observation was conducted after coating a 2 nm thick platinum 30 layer by using a Hitachi e-1030 ion sputter at the pressure of 10 Pa and the current density of 10 mA. The metal ion concentration was determined by an ICP-AES (IRIS INTREPID II XSP, American). XPS spectra were recorded by using VG ESCALAB MARK II with Mg Ka: 1253.6 eV and Step of 0.2 eV.

2.CHNs thin films

![Cross-section SEM image of the CHNs thin films filtered from 30 ml CHNs solution on PC membrane with effective diameter of 1.9 cm.](image)

**Figure S1.** Cross-section SEM image of the CHNs thin films filtered from 30 ml CHNs soltuion on PC membrane with effective diameter of 1.9 cm.
3. XPS spectrum of MIL-110 nanorod arrays

![XPS spectrum](image)

**Figure S2.** XPS spectrum of MIL-110 nanorod arrays as shown in Figure 1b.

4. X-ray Energy dispersive analysis spectra (EDS) of the samples reacting with different time

![X-ray EDS spectra](image)

**Figure S3.** X-ray Energy dispersive analysis spectra of the samples prepared by putting CHNs thin films filtered from 30ml CHNs solution in 30 ml, 1mM H$_2$BTC aqueous solution at 120°C for (a) 3 h, (b) 6 h, (c) 9 h, respectively.
5. The samples prepared in different solvents

**Figure S4.** the SEM images of the samples prepared in 30 ml, 1mM H$_3$BTC (a) octanol, (b) DMF, (c) ethanol solutions; (d-e) 8 mM H$_3$BTC water/ethanol (volume ratio of 1:1) solution, respectively. CHNs filtered from 30 ml CHNs solution were used and kept at 120 °C for 24 hours for all the samples. (f) XRD recorded from (d) the peaks marked as star (*) are belonged to HKUST-1 phase. The peaks marked as triangle (Δ) are assigned to [Cu$_2$(OH)(BTC)(H$_2$O)]·2nH$_2$O. Due to the very less amount of the MIL-110 nanorods, no obviously XRD peaks of MIL-110 phase are observed.
6. EDS and XRD of the samples prepared by using zinc and cadmium hydroxide nanostrands

**Figure S5.** EDS of the samples prepared by putting thin films filtered from (a) 30ml cadmium hydroxide nanostrands, (b) 30ml zinc hydroxide in 30 ml, 1mM H$_3$BTC aqueous solution at 120°C for 24h, respectively.

**Figure S6.** XRD of the samples prepared by putting thin films filtered from (a) 30ml cadmium hydroxide nanostrands, (b) 30ml zinc hydroxide in 30 ml, 1mM H$_3$BTC aqueous solution at 120°C for 24h, respectively.
Reference: