Supporting information

Multi-component luminescent lanthanide hybrids with both functionalized IR-MOF-3 and SBA-15

Xiao Lian and Bing Yan*

Department of Chemistry, Tongji University, Siping Road 1239, Shanghai 200092, China

Experimental section

Chemicals: Chemicals were purchased from commercial sources. All solvents were analytical grade and without further purification. $Eu(NO_3)_3{\cdot}xH_2O$ was prepared by dissolving its oxide Eu_2O_3 in concentrated nitric acid (HNO_3).

Physical characterization: X-ray diffraction patterns (SAXRD) were recorded on a Rigaku D/ max-Rb diffractometer equipped with a Cu anode in a 2θ range from 10to 70^o . Fourier transform infrared spectra (FTIR) were measured within KBr slices from 4000–400 cm^{-1} using a Nexus 912 AO446 infrared spectrum radiometer. Luminescence excitation and emission spectra of the solid samples were obtained on Edinburgh FLS920 spectrophotometer. The outer luminescent quantum efficiency was determined using an integrating sphere (150 mm diameter, $BaSO_4$coating) from Edinburgh FLS920 phosphorimeter. The quantum yield can be defined as the integrated intensity of the luminescence signal divided by the integrated intensity of the absorption signal. The absorption intensity was calculated by subtracting the integrated intensity of the light source with the sample in the integrating sphere from the integrated intensity of the light source with a blank sample in the integrating sphere.

The contents of RE^{3+} ions (RE = Eu, Tb, Nd, Yb) and Zn^{2+} in the hybrids are determined by ICP and the content of C, N element can be determined by elemental analysis. It is hardly to determine the exact composition of them within the complicated hybrid system by the in-situ sol-gel process. For Eu-IRMOF-3-Si-SAB-15: Eu 3.71 %, Zn 6.20 %, C 7.05 %, N 2.02 %; for Tb-IRMOF-3-Si-SAB-15: Tb 3.80 %, Zn 6.13 %, C 6.99 %, N 1.99 %; for Nd-IRMOF-3-Si-SAB-15: Nd 3.62 %, Zn 6.33 %, C 7.12 %, N 2.05 %; for Yb-IRMOF-3-Si-SAB-15: Yb 3.88 %, Zn 6.06 %, C 6.89 %, N 1.95 %. According to the content of RE^{3+}, Zn^{2+} and N, it can be predicted the molar ratio of RE: Zn: N is close to 1: 4: 8. So its chemical composition can be predicted as in Figure S1. Zn: N is 1: 2, which reveals one N is from IRMOF-1 and other is from TEPIC.

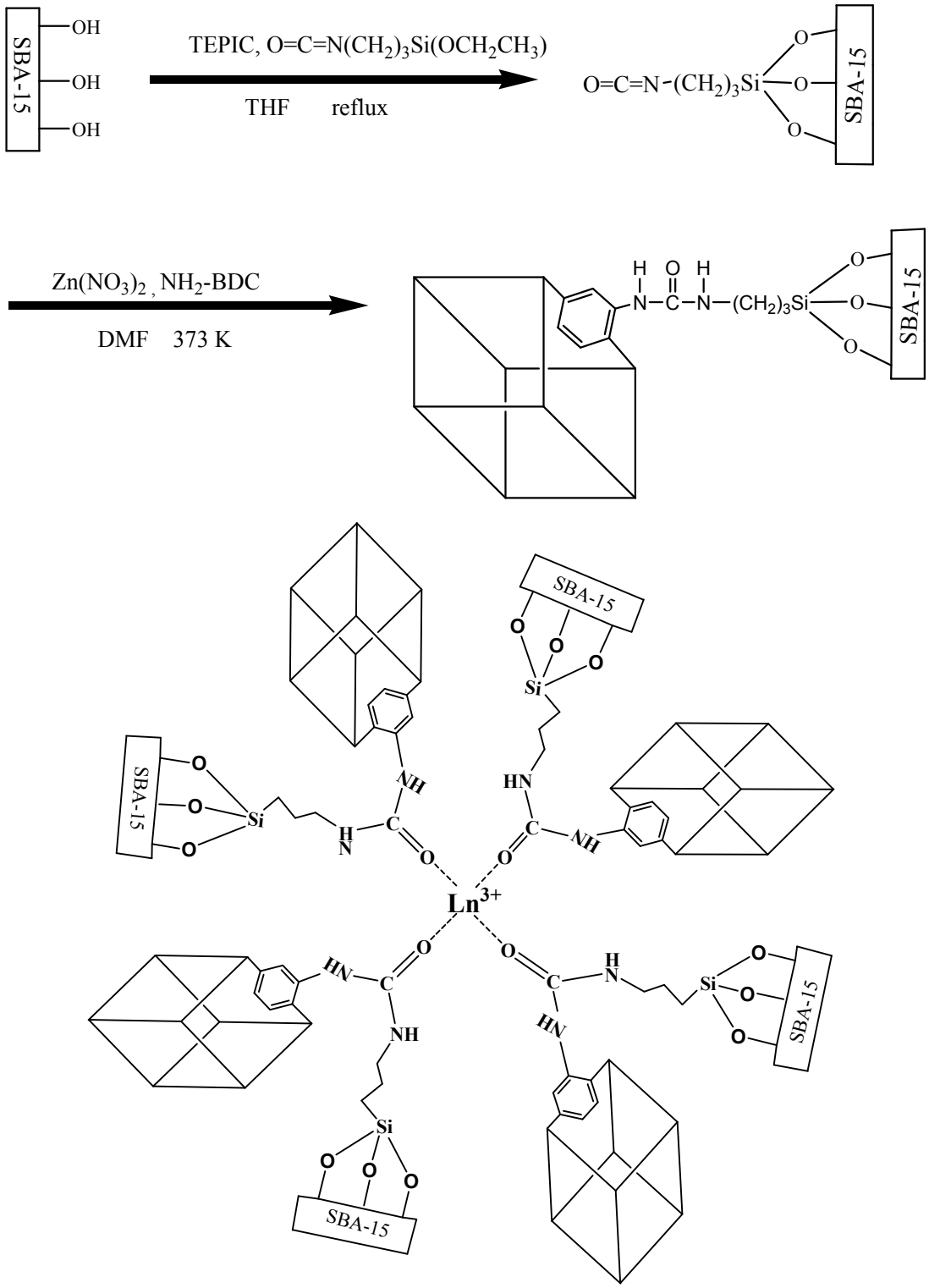

Figure S1 The synthesis process of synthesis process of SBA-15-Si-IRMOF-3 (a), and the schematic diagram of Ln- SBA-15-Si-IRMOF-3.

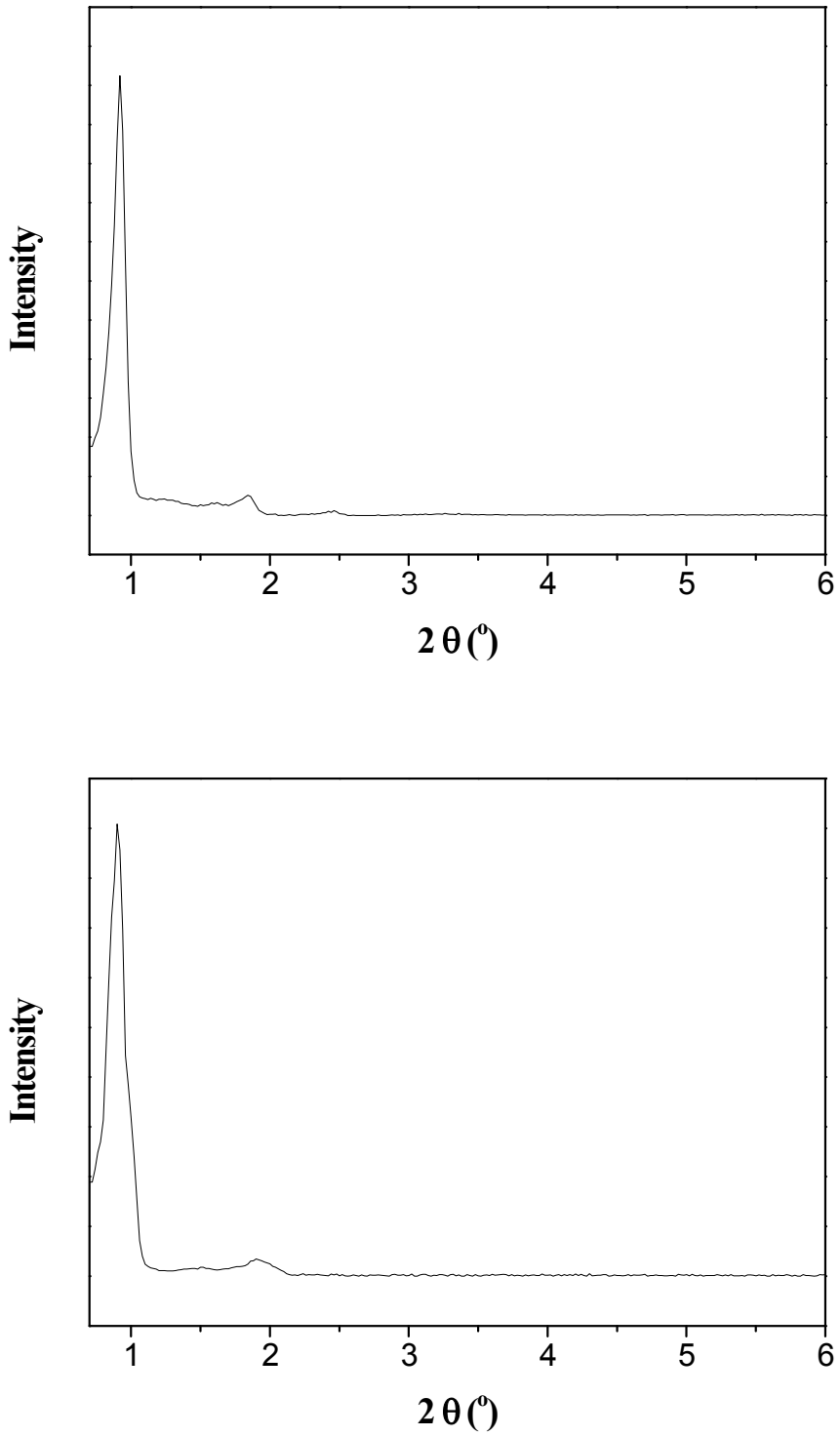

Figure S2 The selected small angle XRD patterns of SBA-15 (top) and Si-SBA-15 (bottom)

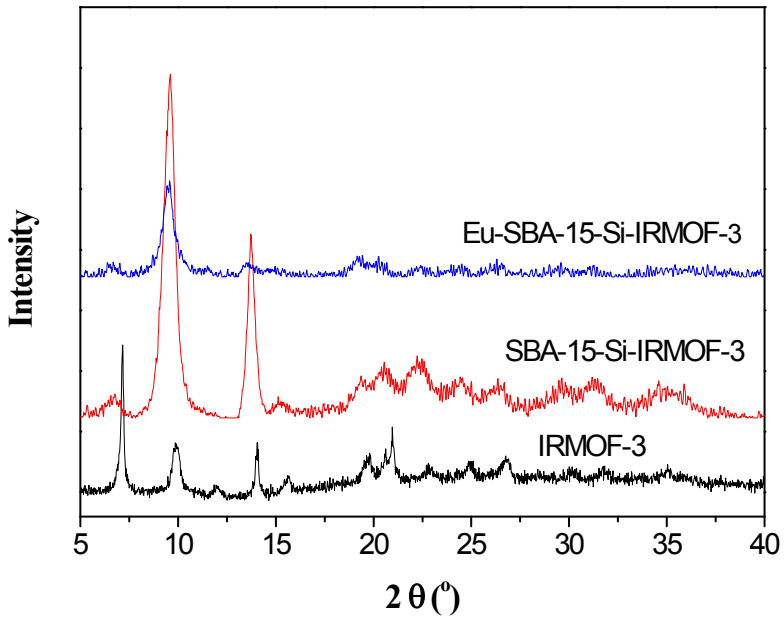

Figure S3 The selected XRD patterns of IRMOF-3, SBA15-Si-IRMOF-3 and Eu-SBA-15-Si-IRMOF-3 hybrid system.

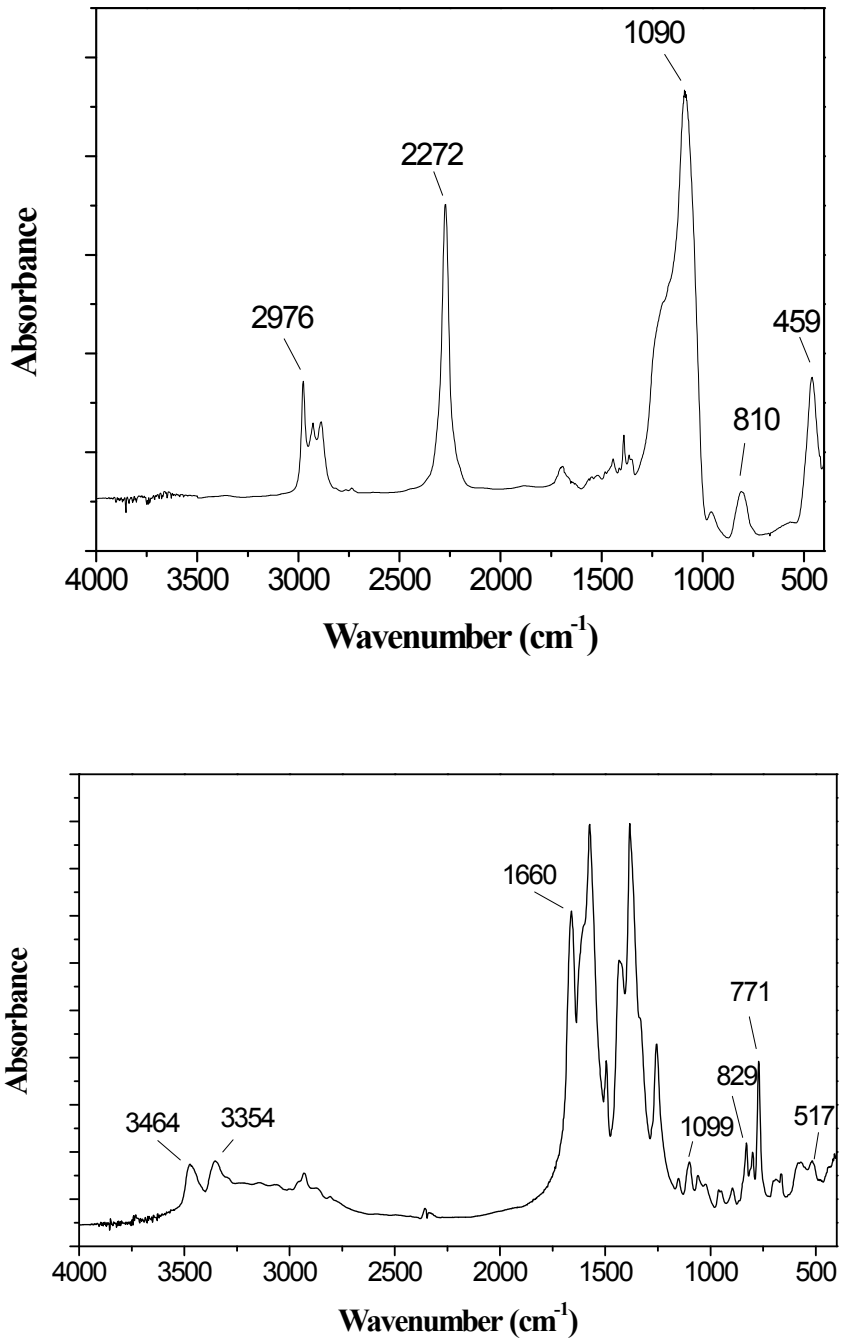

Figure S4 The selected FT-IR spectra of Si-SBA-15 (top) and SBA-15-Si-IRMOF-3 (bottom)

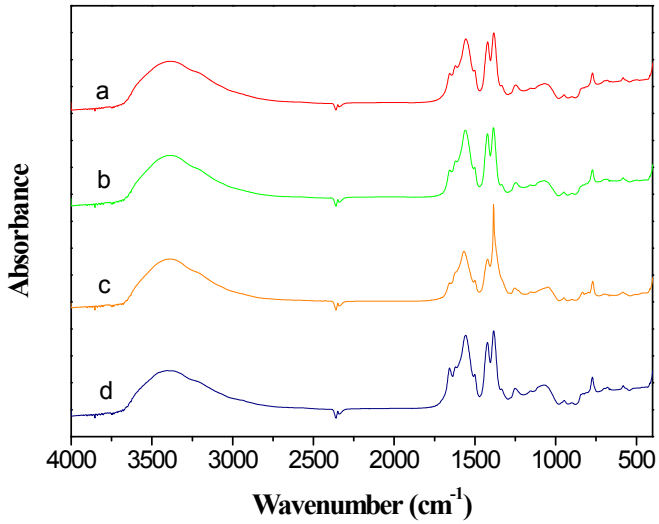

Figure S5 The FT-IR spectra of multi-component hybrids Ln-SBA-15-Si-IRMOF-3 (Ln = Eu, a; Tb, b; Nd, c; Yb, d).

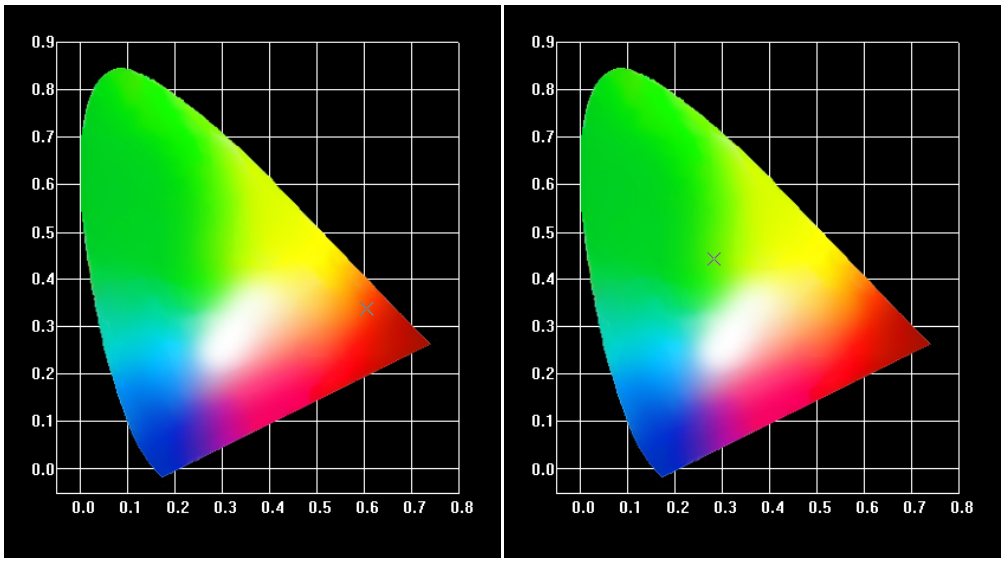

Figure S6 The CIE diagram of hybrids Eu-SBA-15-Si-IRMOF-3 (left) and Tb-SBA-15-Si-IRMOF-3 (right)

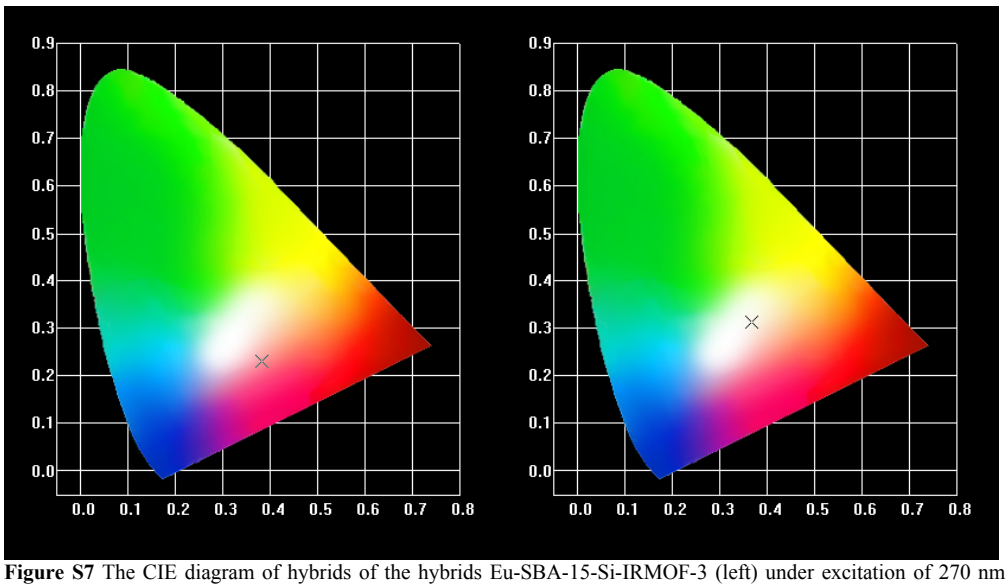

Figure S7 The CIE diagram of hybrids of the hybrids Eu-SBA-15-Si-IRMOF-3 (left) under excitation of 270 nm and Eu/Tb-SBA-15-Si-IRMOF-3 (right).