Electronic Supplementary Information

Carbon dots encapsulated UiO-type metal organic framework as multifunctional fluorescence sensors for temperature, metal ion and pH detection

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Experimental

Materials preparation: All chemicals were commercially available and used as received without purification. Typically, $ZrOCl_2 \cdot 8H_2O$ (32.2 mg, 1 mmol), 2,5-dihydroxyterephthalic acid (BDC-$(OH)_2$) (19.8 mg, 1 mmol) and tetraethylammonium bromide (29.8 mg, 1.42 mmol) were mixed and ground in a mortar by hand for 5 min at room temperature. Then the mixtures were transferred into a 25 mL of autoclave, which was crystallized at 180 ºC for 24 h. During the hydrothermal process, CDs were formed *in-situ* and encapsulated into UiO-66$(OH)_2$ to give the final product of CDs@UiO-66$(OH)_2$, which was cooling to room temperature, and washed with ethanol and dried under vacuum for 2 h at 60ºC.

Materials characterization: Powder X-ray diffraction patterns (PXRD) were collected on a X'Pert Pro MRDDY2094 diffractometer with Cu-Kα radiation (λ = 1.5418 Å). A scan rate of 0.0167º s^{-1} was applied to record the pattern in the 2θ range of 5–50º. Ultra plus field emission scanning electron microscope (SEM, Hitachi, SU8010) was used to characterize the morphologies of the samples. Transmission electron microscopy (TEM) and high resolution transmission electron microscope (HRTEM) were conducted using a JEM-2100F electron microscopy (JEOL, Japan). N_2 sorption isotherms were performed on an ASAP 2020 instrument. The X-ray photoelectron spectroscopy (XPS, Thermo Fisher Scientist Co., Theta Probe) was used to study the surface chemical composition of CDs@UiO-66$(OH)_2$.

Photoluminescence (PL) measurement: The photoluminescence (PL) spectra and the temperature dependence luminescence properties were measured on a fluorescence spectrophotometer (Horiba FMax-4) attached with a heating furnace (Luma 40^{TM}/Horiba4). An electric heating attachment coupled with circulating cooling water pipes were introduced into the sample chamber of fluorescence spectrophotometer (Horiba FMax-4) to carry out the fluorescence measurement at different temperatures.

For the investigation of the relationship of pH and luminescent properties of CDs@UiO-66$(OH)_2$, 3 mg of CDs@UiO-66$(OH)_2$ samples were immersed in 3 mL aqueous solution of different pH ranging systematically from 3.0 to 7.0 adjusted by 0.1 M HCl. The solution was sonicated completely for 3 min to form emulsions. The fluorescent intensity of CDs@UiO-66$(OH)_2$ solutions at different pH values is monitored with fluorescence spectrometer (Horiba FMax-4).

For the fluorescence response of CDs@UiO-66$(OH)_2$ towards various metal ions, including Zn^{2+}, Ni^{2+}, Na^{+}, Mn^{2+}, K^{+}, Ba^{2+}, Cu^{2+}, Cr^{3+}, Co^{2+}, Cd^{2+}, and Fe^{3+}, 3 mg of as-prepared CDs@UiO-66$(OH)_2$ were dispersed into

water solution containing 10^{-2} M of different metal ions, and the solutions were sonicated for 3 min to ensure the uniform dispersion of samples. Different quenching effects of various metal ions for the fluorescent intensity of CDs@UiO-66$(OH)_2$ is monitored with fluorescence spectrometer (Horiba FMax-4).