Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Encapsulation of Yellow Phosphors into Nanocrystalline Metal-Organic Frameworks for Blue-Excitable White Light Emission

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Materials

Cetyltrimethylammonium bromide(CTAB, Beantown Chemical, 98%), 2-methylimidazole (Acros Organics, 99%), zinc nitrate hexahydrate($Zn(NO_3)_2 \cdot 6H_2O$, Alfa Aesar, 99%), rhodamine 6G (R6G, Sigma-Aldrich, 99%)were purchased from the mentioned sources and used without further purification.

Characterization

The fluorescence spectra were measured using fluoromax-4 spectrofluorometer, Horiba Scientific. The quantum yield was obtained using absolute PL quantum yield spectrometer C11347. Powder X-ray diffraction patterns were measured using Ultima IV X-ray diffractometer with Cu Kα radiation. Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) images were obtained on JEOL JEM2010F operated at 200 kV and JEOL JSM6340F, respectively.

Synthesis of R6G@ZIF-8

5mL aqueous solution containing 2.72M 2-methylimidazole and 0.55 mM CTAB was stirred for 1 minute, followed by addition of 5mL 300 mg $Zn(CH_3COO)_2 \cdot 2H_2O$ aqueous solution. After the mixture was stirred for 10 seconds, different amount of 5 mM R6G aqueous solution (0.10 mL, 0.25 mL, 0.50 mL and 0.75 mL) was added. The mixture was stirred for another 10 seconds and then was left undisturbed for 2 hours at room temperature. The synthesized R6G@ZIF-8 was spun down at 9000 rpm for 10 minutes and washed twice using methanol.[1]

Synthesis of R6G@ZIF-8@ZIF-8 (R6G@ZIF-8^2)

As-synthesized R6G@ZIF-8 was dispersed into 40 mL methanol solution containing 30 mM 2-methylimidazole. After shaking for 10 seconds, 40 mL 30 mM $Zn(NO_3)_2 \cdot 6H_2O$ methanol

solution was added and the mixture was shook for another 10 seconds. Then solution was left undisturbed at room temperature for 1 hour. The formed R6g@ZIF-8[2] was spun down at 6000 rpm for 10 minutes and washed using methanol.[2]

Synthesis of UiO-66

50 mg 1,4-benzenedicarboxylic acid and 21 mg zirconyl chloride octahydrate were added into 4 mL DMF and 2 mL acetic acid. After a brief sonication, the mixture was heated at 90 ℃ for 6 hours. The formed UiO-66 was spun down at 8000 rpm for 10 minutes and washed twice using methanol.[3]

Synthesis of DBNT@UiO-66

1.00 g 1,4-benzenedicarboxylic acid and 0.42 g zirconyl chloride octahydrate were added into 60 mL DMF and 40 mL acetic acid. After the temperature of this mixture was up to 90 ℃, 50 mg DBNT in 20 mL DMF was added. The solution was stirred for another 10 minutes and no disturbed for 6 hours at the same temperature. The formed DBNT@UiO-66 was spun down at 8000 rpm for 10 minutes and washed using DMF and methanol.

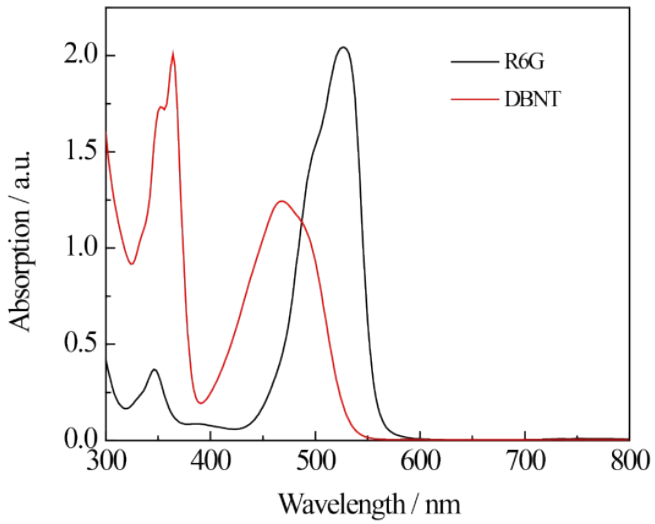

Fig. S1. The absorption spectra of R6G in water and DBNT in DMF.

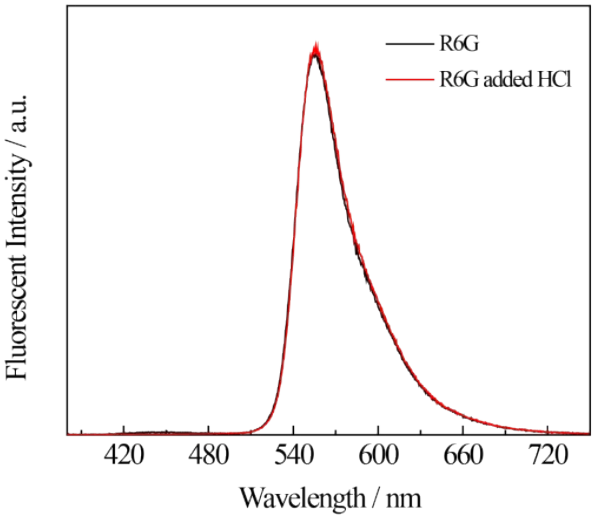

Fig. S2. The fluorescence spectra of R6G in water and R6G in water after acid digestion of R6G@ZIF-8[2] (pH: ~3-4).

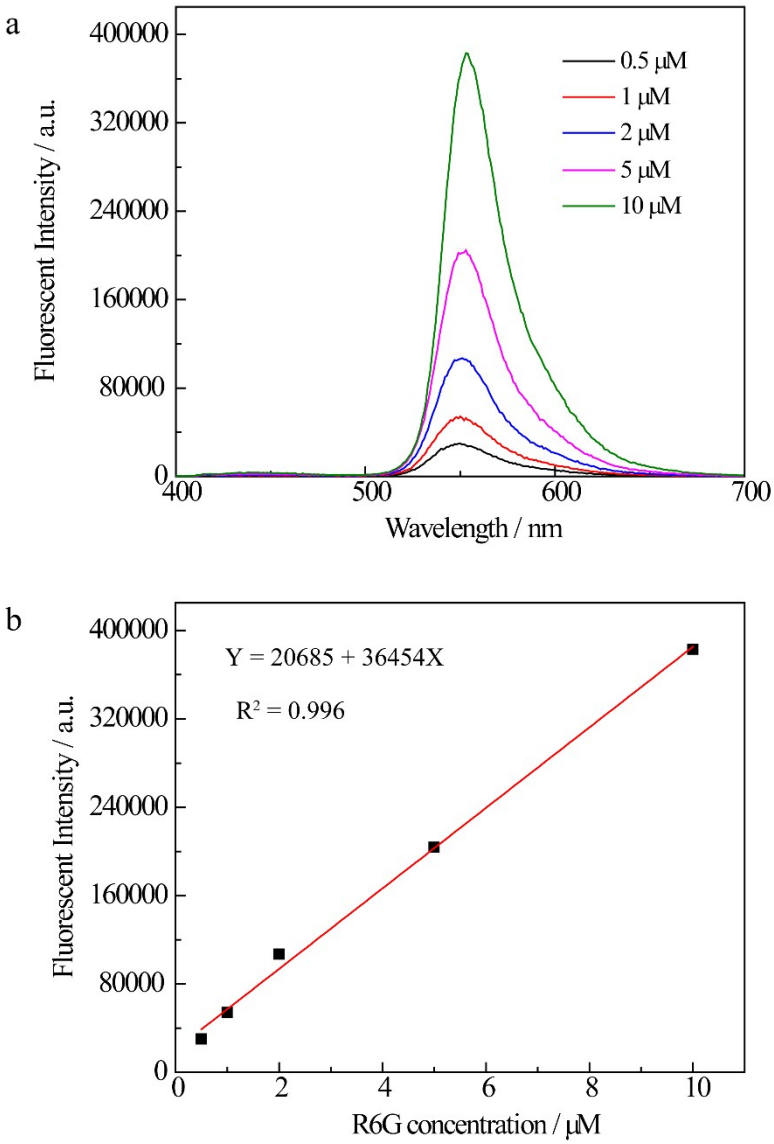

Fig. S3. (a) Fluorescence intensity of R6G in water at different concentrations, and (b) the corresponding standard curve.

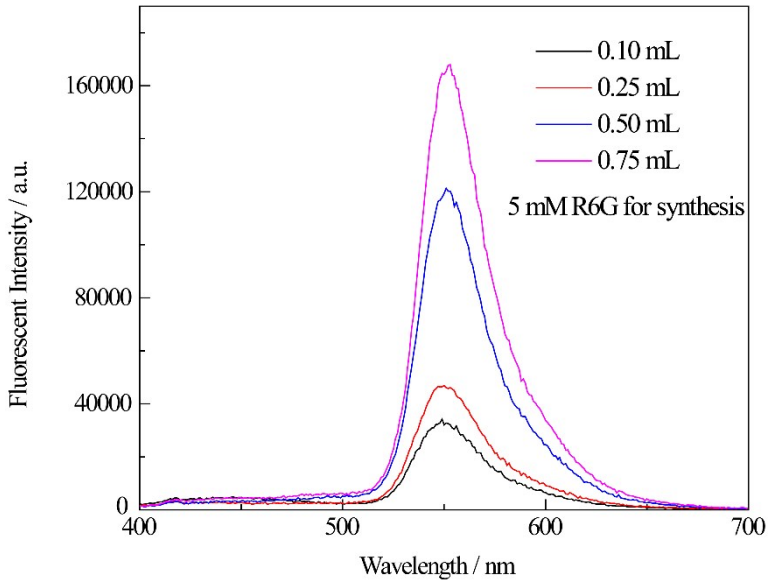

Fig. S4.The fluorescence spectra of R6G@ZIF-8[2] (digested using HCl) solution with different concentrations of R6G used in the synthesis.

Based on the calculation using the data from Figure S1 and S2, when 0.10, 0.25, 0.50 and 0.75 mL R6G was used in the synthesis of R6G@ZIF-8, the corresponding mass percentage of RG6 in the R6G@ZIF-8[2] is 0.0033, 0.0067, 0.0264 and 0.0388 wt%, respectively.

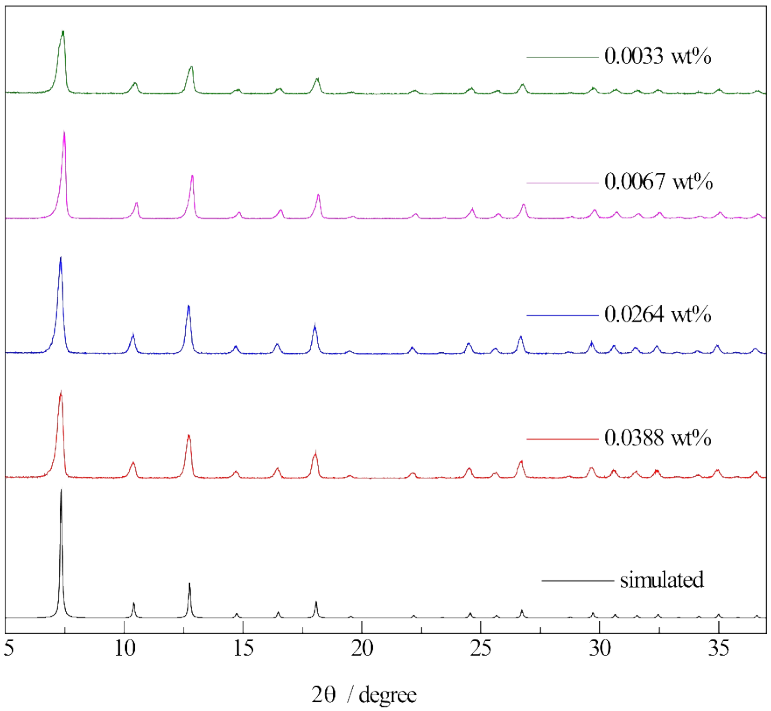

Fig. S5. PXRD patterns of simulated ZIF-8 and R6G@ZIF-8[2] with different concentrations of encapsulated R6G.

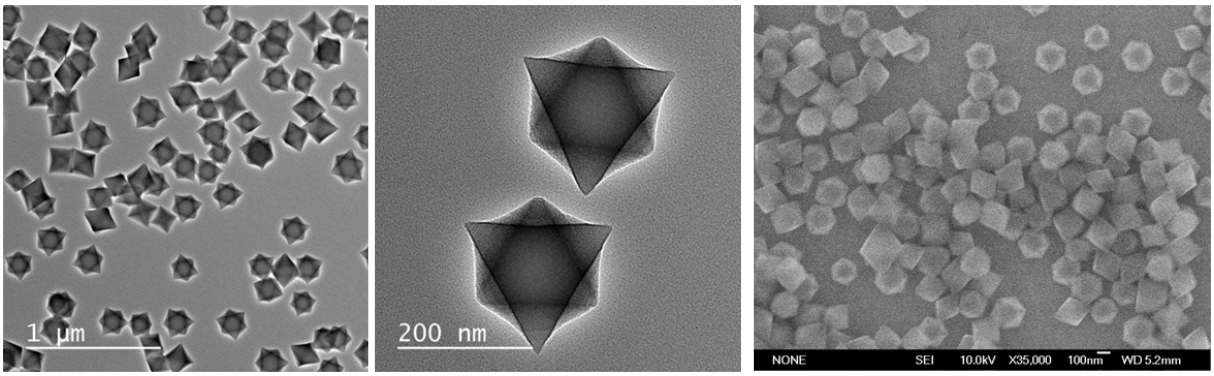

Fig. S6.The TEM and SEM images of UiO-66 nanocrystals.

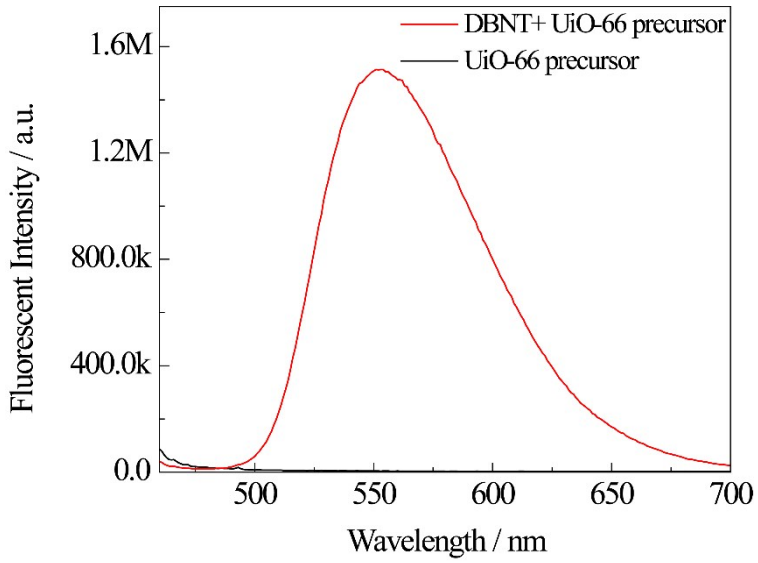

Fig. S7. The fluorescences pectra of UiO-66 precursor and DBNT+UiO-66 precursor (excited at 450 nm).

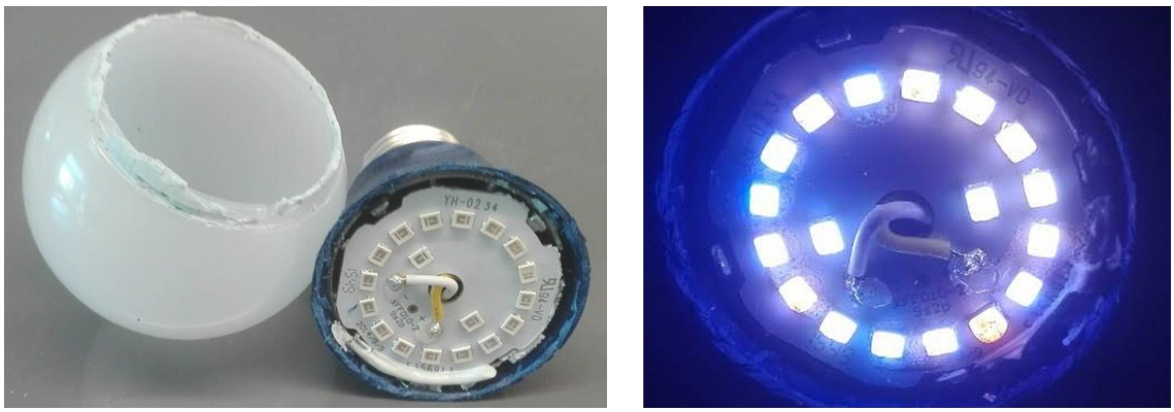

Fig. S8. Photographs of 450 nm blue LED bulb (composed of multiple blue chips, left) and R6G@ZIF-8[2] coated chips when the power is turned on (right).

References

[1] C. Avci, I. Imaz, A. Carne-Sanchez, J. A. Pariente, N. Tasios, J. Perez-Carvajal, M. I. Alonso, A. Blanco, M. Dijkstra, C. Lopez, D. Maspoch, *Nat.Chem.***2018**, *10*, 78-84.

[2] L. Y. Chou, P. Hu, J. Zhuang, J. V. Morabito, K. C. Ng, Y. C. Kao, S. C. Wang, F. K. Shieh, C. H. Kuo, C. K. Tsung, *Nanoscale* **2015**, *7*, 19408-19412.

[3] S. Wang, C. M. McGuirk, M. B. Ross, S. Wang, P. Chen, H. Xing, Y. Liu, C. A. Mirkin, *J. Am. Chem. Soc.* **2017**, *139*, 9827-9830.