

Supporting Information

Visible-excitable long-afterglow material with dual-mode emission of delayed fluorescence and room temperature phosphorescence

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Materials. Fluorescein and sodium fluorescein were purchased from Tianjin Hiens Biochemical Technology Co. Boric acid and methanol were purchased from Aladdin Biochemical Technology Co. Anhydrous ethanol was purchased from Shanghai Macklin Biochemical Co. Ultrapure water was obtained from an ultrapure water machine in the lab.

Characterization.

Steady-state photoluminescence/phosphorescence spectra, fluorescence/phosphorescence lifetime were measured using Edinburgh FLS-980. Photoluminescence quantum efficiency was obtained on Edinburgh FLS-980 fluorescence spectrophotometer equipped with an integrating sphere. The material structure was examined by a transmission electron microscope (TEM) JEM-2100F, field emission scanning electron microscope (F-SEM) MAIA3 LMH and X-ray photoelectron spectrometer (XPS) ESCALAB Xi+. The solid-state UV-vis spectra were obtained on a PE lambda 950 spectrometer from 200 to 600 nm. FT-IR spectra were performed compound in the range of 4000–650 cm^{-1} on a Thermo Fisher FT-IR spectrophotometer (Nicolet iS50). Powder XRD pattern was measured with a Shimadzu LabX XRD-6100. The thermogravimetric analysis (TGA) measurements were performed on a HITACHI STA200 simultaneous thermal analyzer with a heating rate of 10 $^{\circ}\text{C}/\text{min}$ from room temperature to 800 $^{\circ}\text{C}$ at N_2 atmosphere. The luminescent photos were taken by iPhone 14 Pro under the irradiation of a hand-held UV lamp at room temperature.

Synthesis of BA@Fluo

The fluorescein was dissolved in 20 mL of methanol/water to obtain 0.5 mg/mL solution. Add 6.2 g BA to a beaker containing 40 mL methanol and heat at 60 $^{\circ}\text{C}$ until the BA powder is completely dissolved. The beaker was then cooled in a cold-water bath until the solid was no longer precipitated. The precipitated solid was separated from the solvent by filtration under reduced pressure, and then the recrystallized BA was dried in an oven for use. The 3 g recrystallized BA was weighed into a 50 mL low-profile beaker and 2 mL of 0.5 mg/mL fluorescein solution was measured and added. Then, the 38 mL of ultrapure water was measured and poured into the beaker and ultrasonicated, and the treated solution was sealed with tin foil and then transferred to an oven at 200 $^{\circ}\text{C}$ for 5 h. When it was reduced to room temperature, it was taken out to obtain BA@Fluo.

1. Characterization

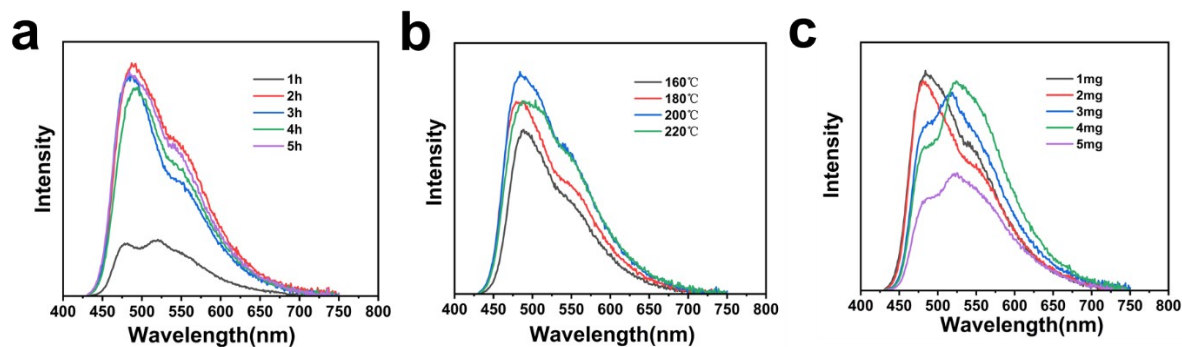


Figure S1. (a) The phosphorescence spectra of BA@Fluo at the different reaction time. (b) The phosphorescence spectra of BA@Fluo at the different reaction temperature. (c) The phosphorescence spectra of BA@Fluo at the different concentration.

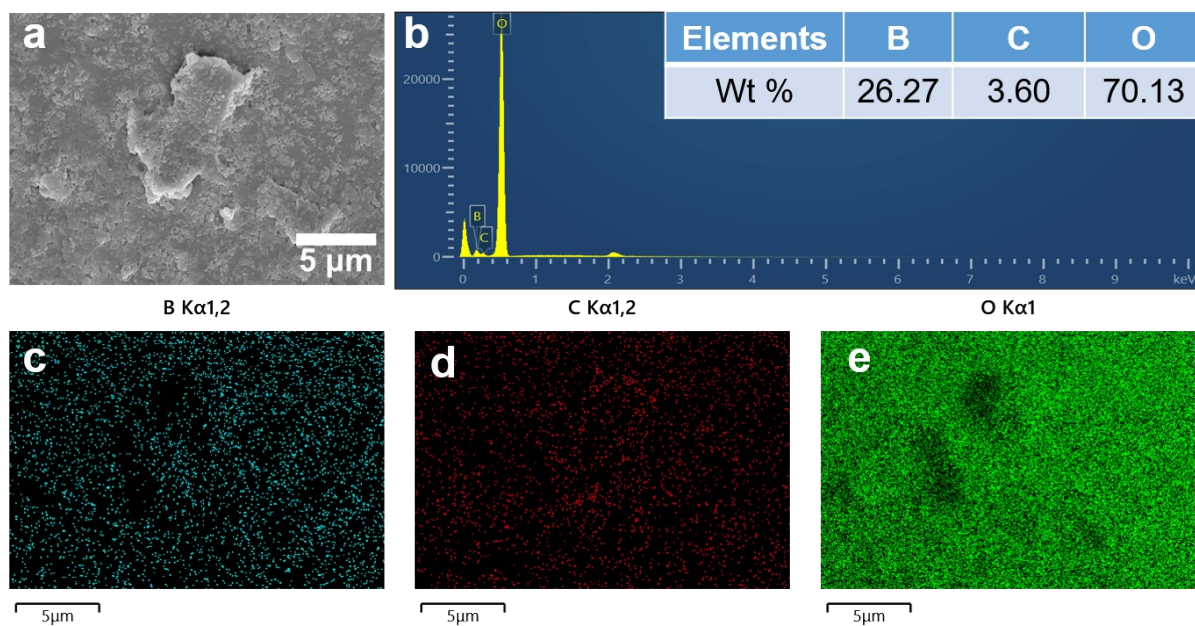


Figure S2. (a) SEM image of BA@Fluo. (b) Elemental analysis content map. (c), (d) and (e) B, C and O content distribution.

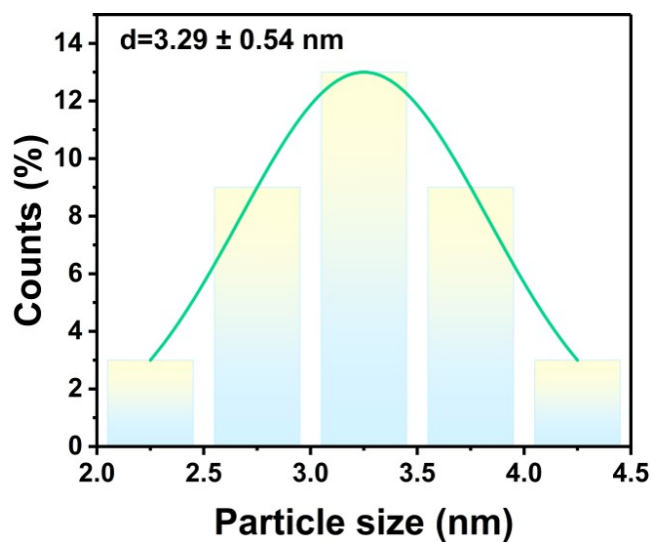


Figure S3. Size distribution statistics corresponding to figure 2b.

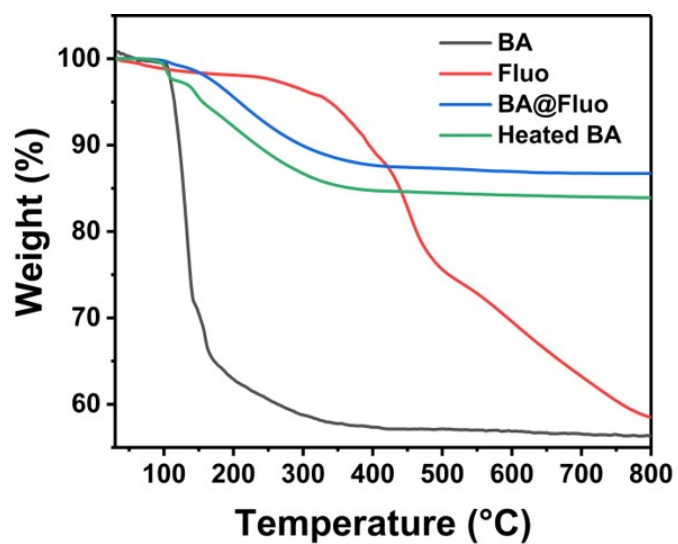


Figure S4. TGA curves of BA, Fluo, BA@Fluo and Heated BA.

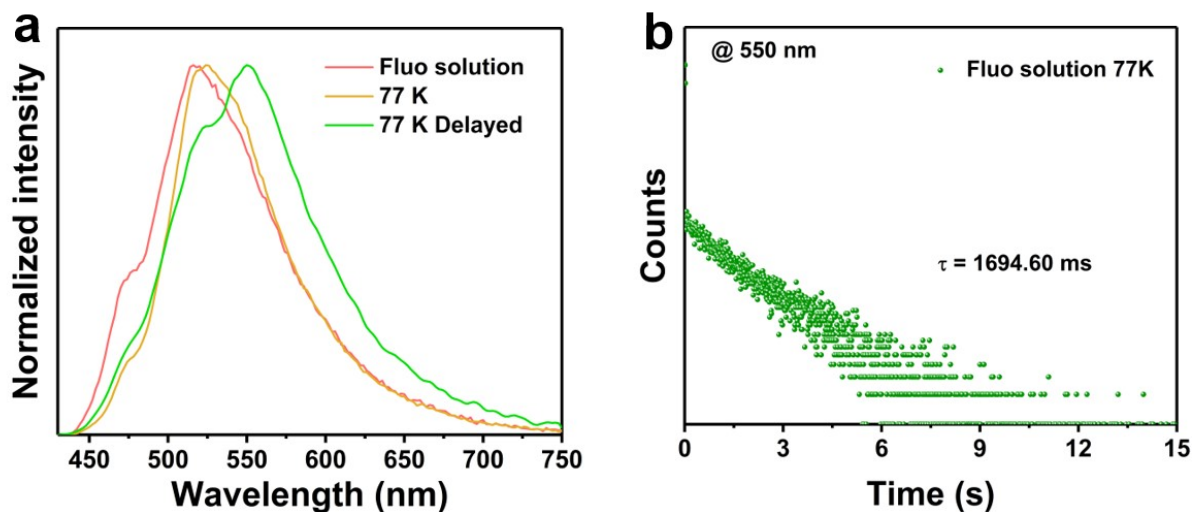


Figure S5. (a) PL and delayed spectra of fluorescein solution at room temperature and at 77 K. (b) Time-resolved phosphorescence decay curve of fluorescein solution at 550 nm under 77 K.

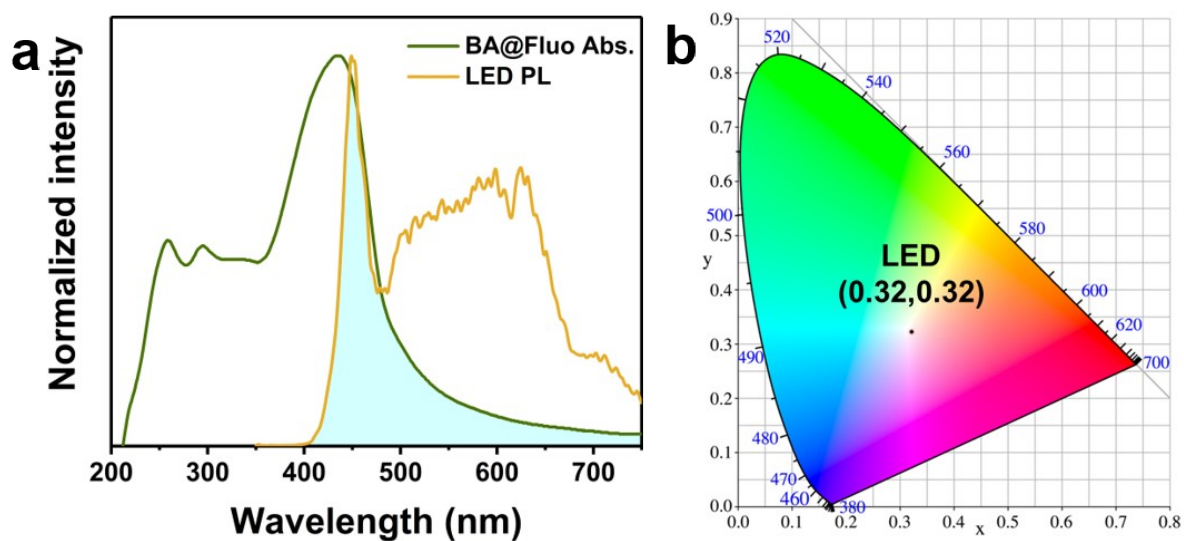


Figure S6. (a) Absorption spectra of BA@Fluo and emission spectra of LED lights. (b) CIE diagrams for LED lights.

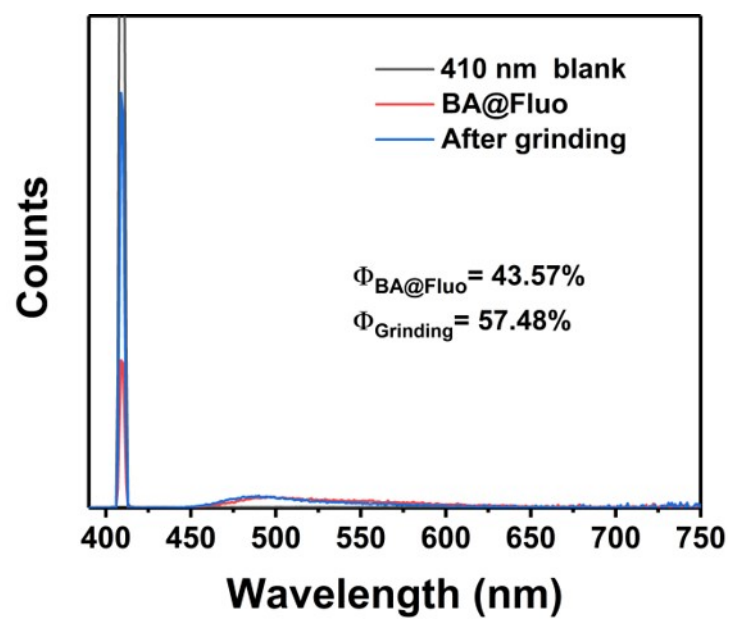


Figure S7. Absolute quantum yield of BA@Fluo before and after grinding.