An afterglow probe using room-temperature phosphorescence-active boronate particles

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Organic room-temperature phosphorescence (RTP) materials have great promise for numerous applications such as bio-imaging and security inks, due to their long-lived lifetimes, large Stokes shifts, and diverse excited state.[1] A promising approach to obtain RTP materials with enhanced intersystem crossing rate constants is to use heavy atoms and El-Sayed's rule. However, they generally show a short-lived lifetime at room temperature, making it hard to detect afterglow. We previously developed sequential dehydration of benzene-1,4-diboronic acid with pentaerythritol to produce a dispersible boronate particle (**BP**) that exhibited RTP behavior with a green afterglow in water.[2] This phenomenon motivated us to investigate ratiometric afterglow-based sensing systems, which led us to fabricate the lactam-ring-containing rhodamine-grafted **BP**s.

Here, we prepared salicylimine-linked rhodamine (**1**) *via* condensation of hydrazine rhodamine dye and 3-formyl-4-hydroxyphenyl boronic acid, which was easily grafted onto the surface of **BP** to give **1@BP** with a greenish afterglow. Furthermore, we found that the addition of Al^{3+} into the dispersion solution of **1@BP** caused a new emission band at 585 nm (Fig. 1a) and changed the afterglow from green to yellowish due to the Förster-type energy transfer in the excited triplet state of **BP** to the excited singlet state of **1** (Fig. 1b).[3] This study proposes the new strategy to develop a color-variable afterglow probe for metal ions detection.

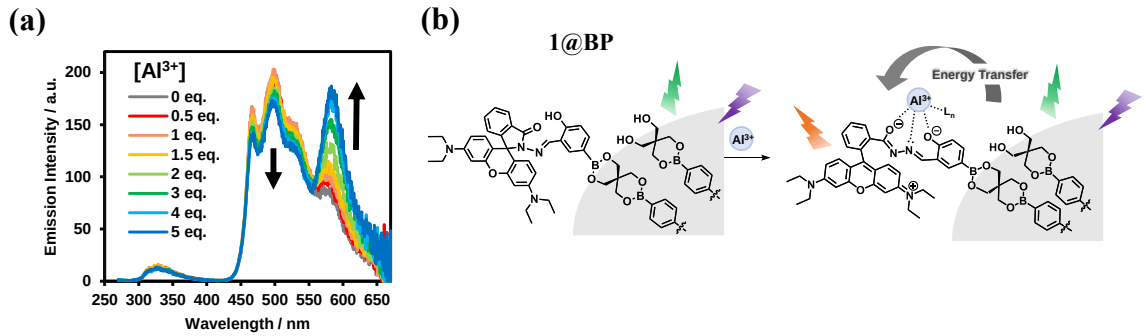

Fig. 1 (a) Delayed emission spectra of **1@BP** (0.5 mg mL^{-1}) upon adding $Al(ClO_4)_3$ in $MeOH/H_2O$ (95:5 v/v). λ_{ex} = 254 nm, delay time = 50 ms, and room temperature; (b) a plausible mechanism of afterglow sensing toward Al^{3+}.

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