**Electronic Supplementary Information (ESI)**

# A built-in self-calibrating luminescent sensor based on RhB@Zr-MOF for cations, nitro explosives and pesticides detection

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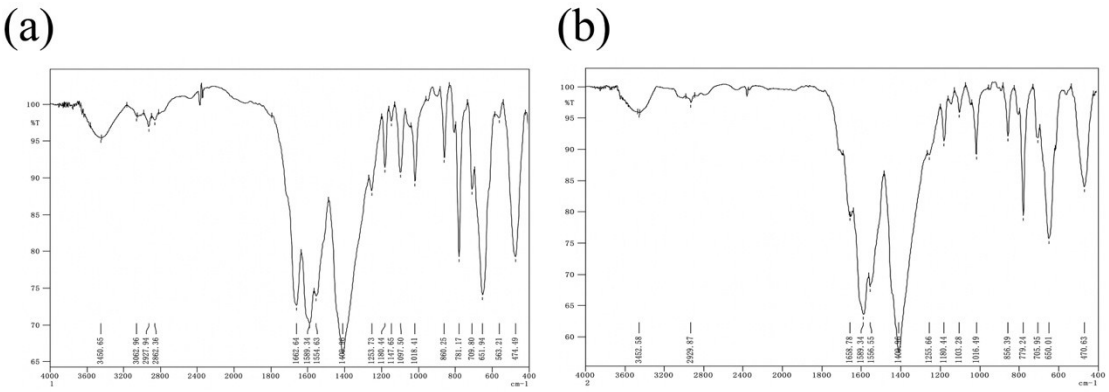


**Fig. S1.** (a) IR spectra of Zr-MOF. (b) IR spectra of **RhB@Zr-MOF**.

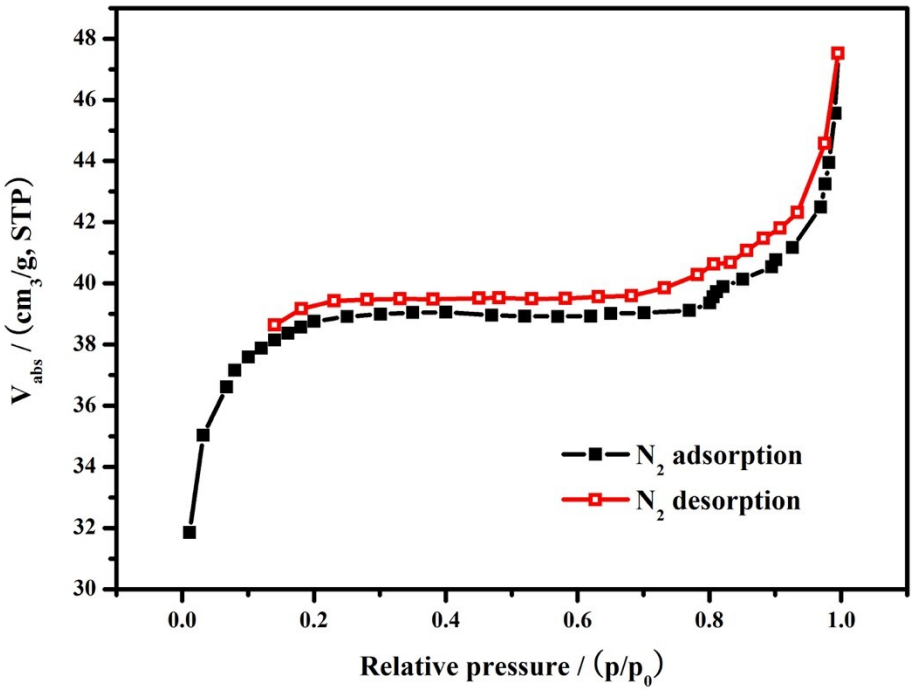


**Fig. S2.** $N_2$ adsorption isotherm of **RhB@Zr-MOF** at 77 K.

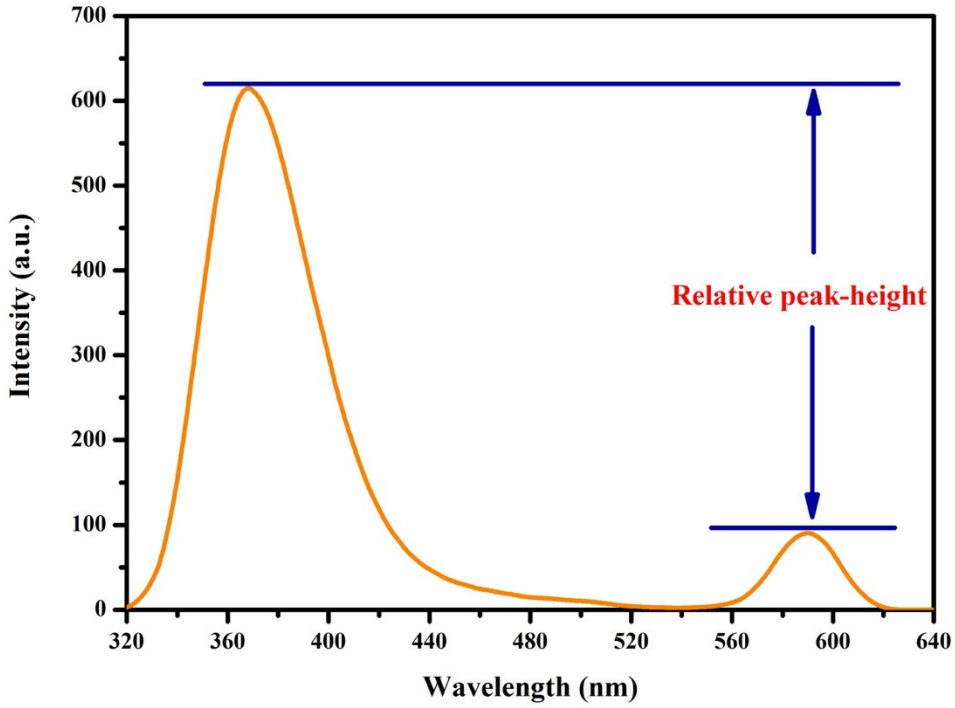


**Fig. S3.** The definition of relative peak-height.

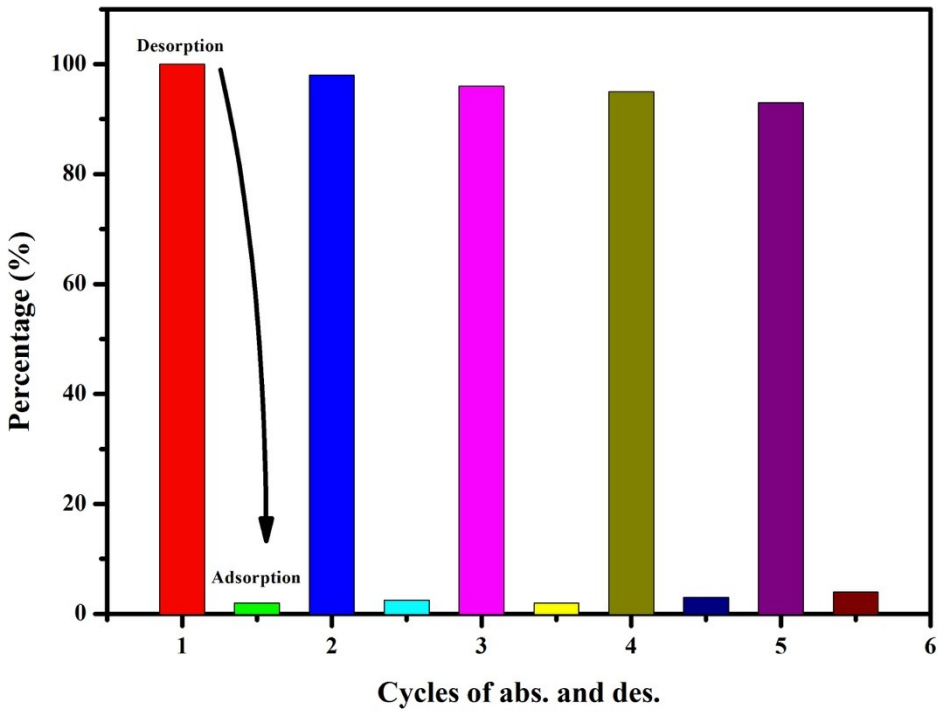


**Fig. S4.** Recycling test on sensing $Fe^{3+}$ in $H_2O$ by **RhB@Zr-MOF** composite.

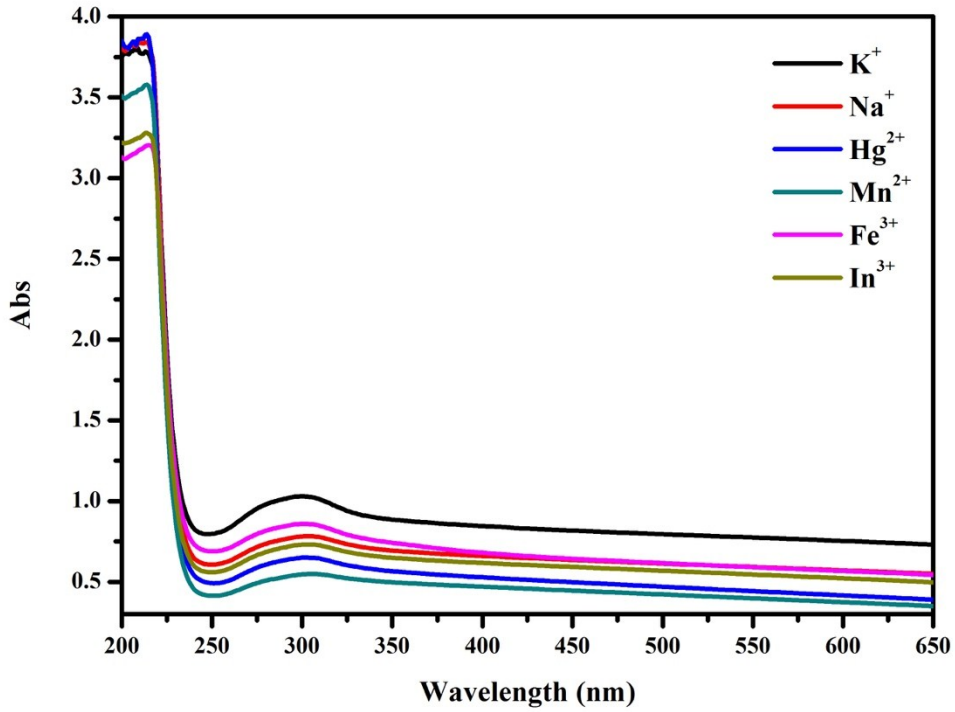


**Fig. S5.** UV-Vis spectra of **RhB@Zr-MOF** with different cations in $H_2O$.

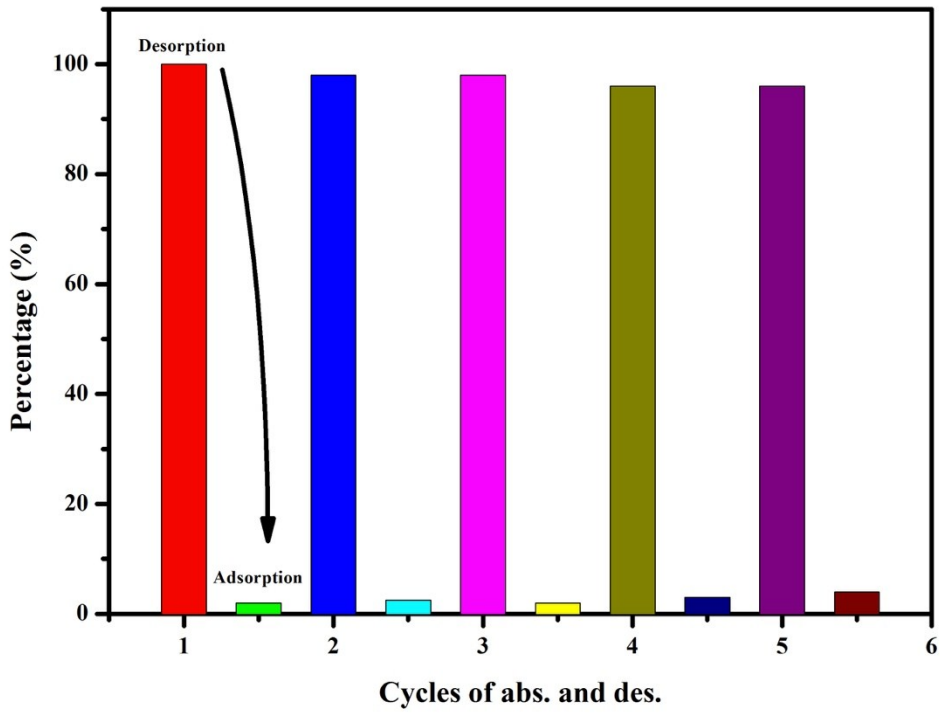


**Fig. S6.** Recycling test on sensing 4-NP in ethanol solution by **RhB@Zr-MOF** composite.

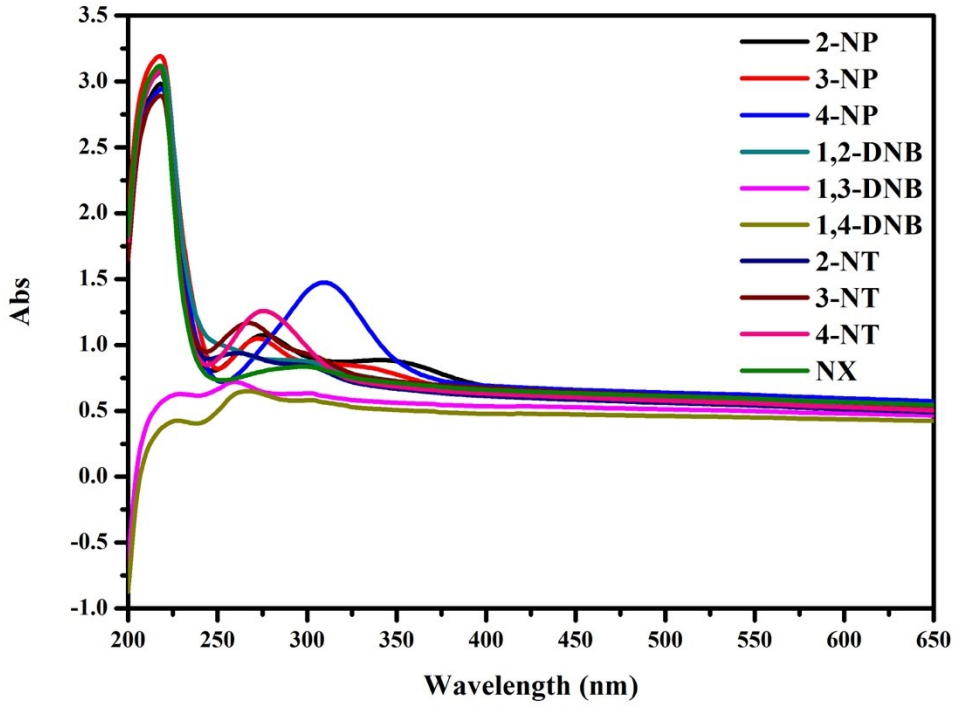


**Fig. S7.** UV-Vis spectra of **RhB@Zr-MOF** with different nitro explosive in ethanol solution.

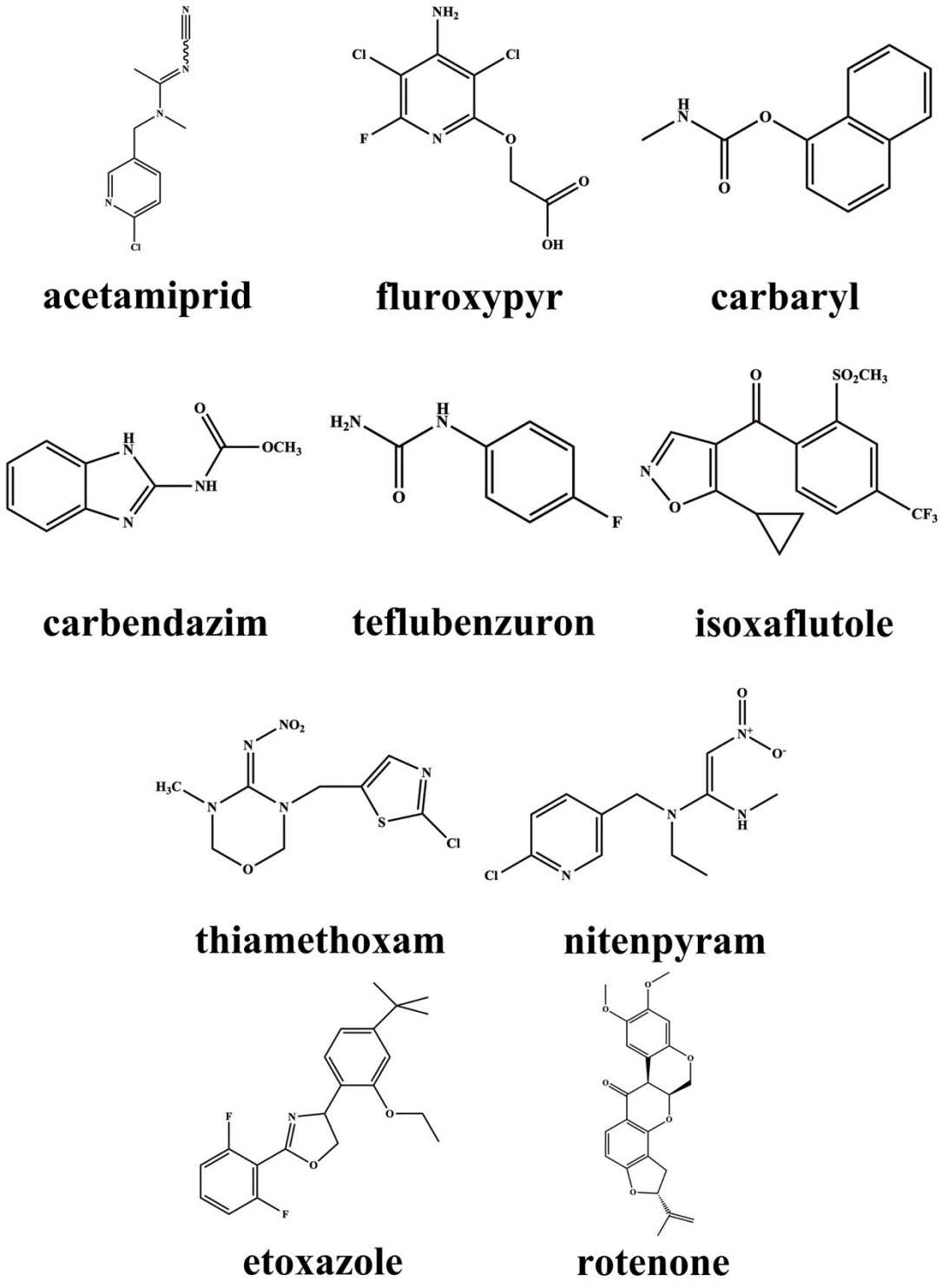


**Fig. S8.** The structures of the pesticides used in this work.

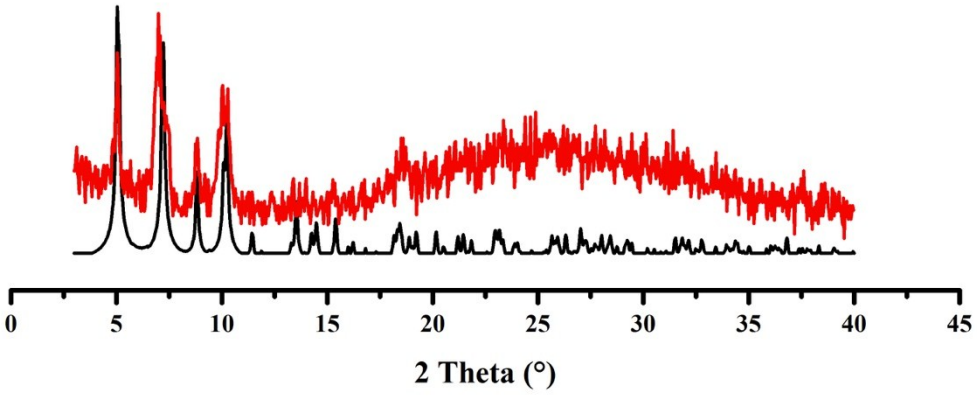


**Fig. S9.** PXRD powder diffraction patterns of simulated (black), and **RhB@Zr-MOF** centrifugated from ethanol solutions of pesticides (red).

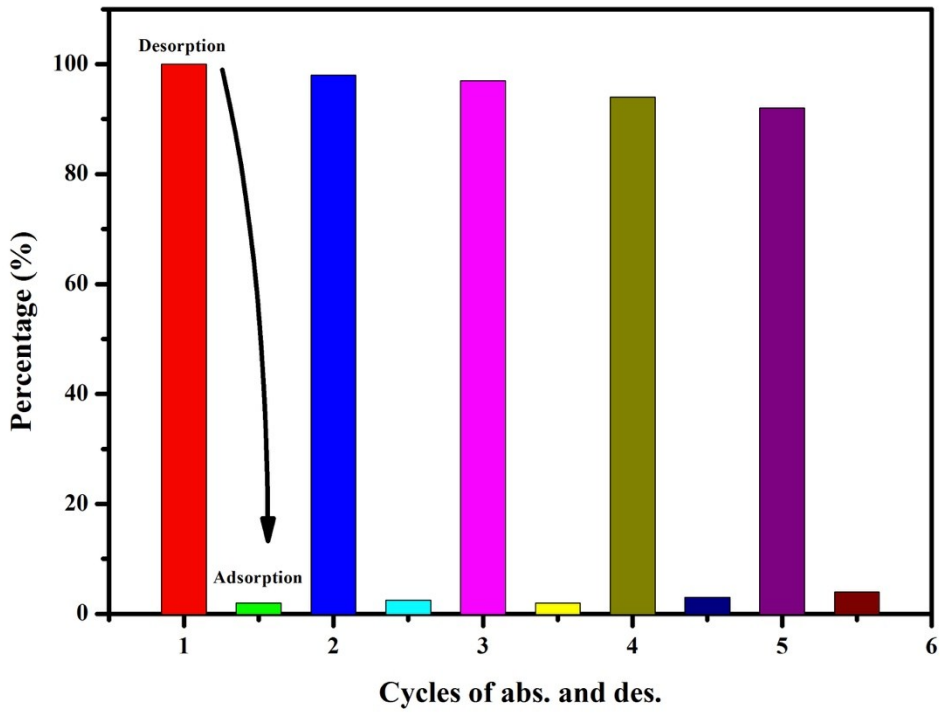


**Fig. S10.** Recycling test on sensing nitenpyram in ethanol solution by **RhB@Zr-MOF** composite.

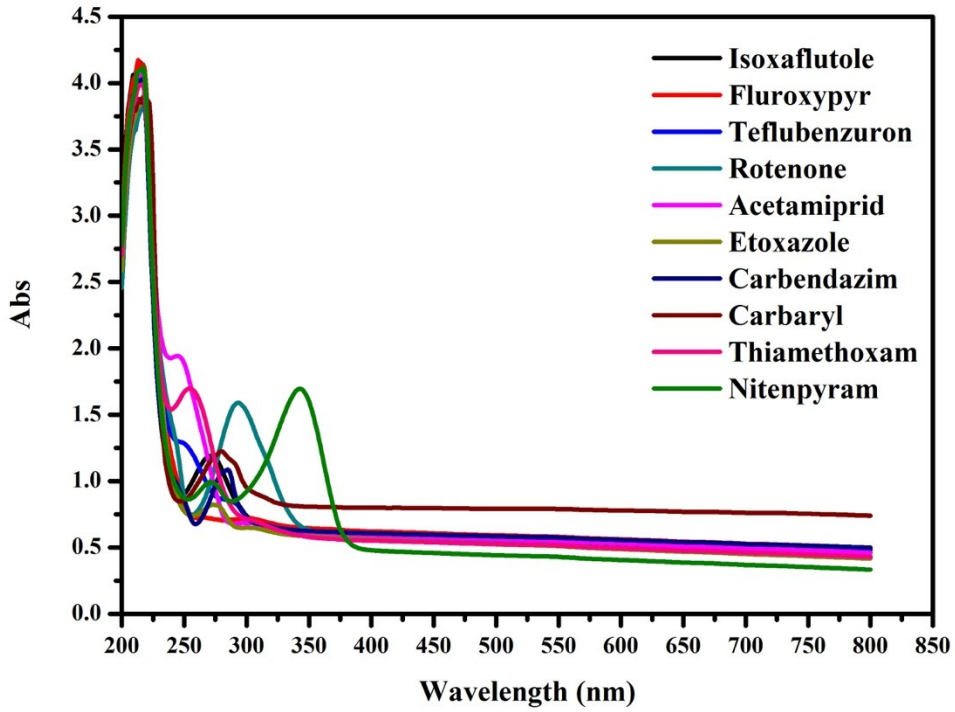


**Fig. S11.** UV-Vis spectra of **RhB@Zr-MOF** with different pesticides in ethanol solution.

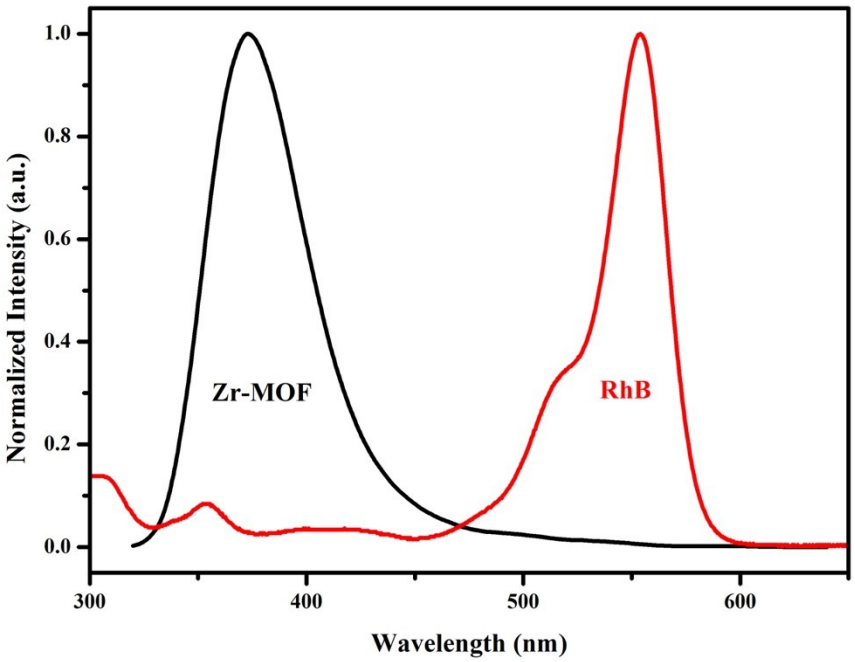


**Fig. S12.** Normalized emission spectrum of Zr-MOF in the solid state (black) and absorption spectrum of RhB in aqueous solution (red, 0.01 g $L^{-1}$).

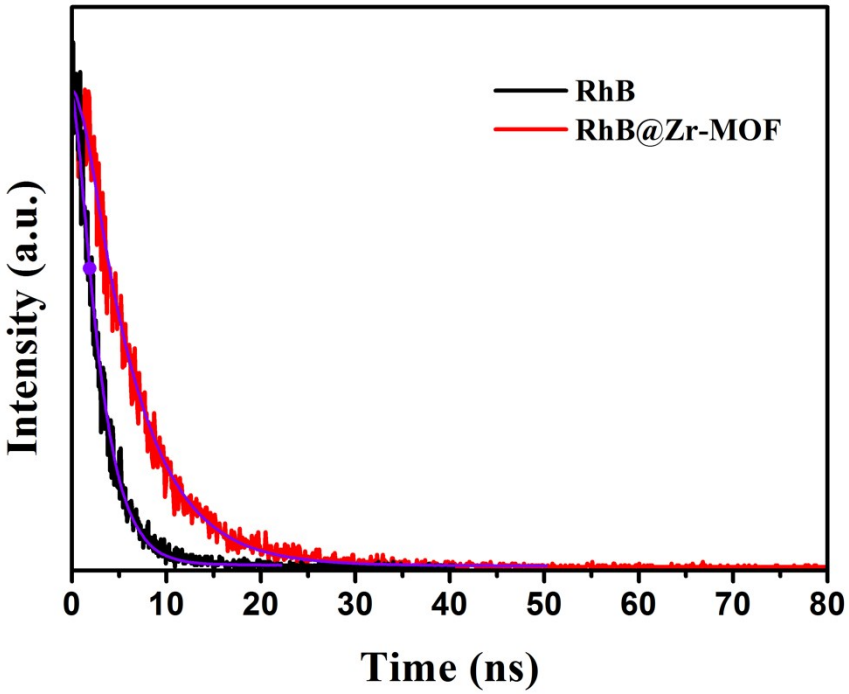


**Fig. S13.** Luminescence decay curves of RhB in aqueous solution (10 mg $L^{-1}$) and **RhB@Zr-MOF** in the solid state.

| Analytes | $Cu^{+}$ | $Ba^{2+}$ | $K^{+}$ | $Mg^{2+}$ | $Ag^{+}$ | $Na^{+}$ | $Cd^{2+}$ | $Co^{2+}$ | $Cu^{2+}$ | $Hg^{2+}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| RLI value | 1.50 | 1.49 | 1.47 | 1.42 | 1.41 | 1.37 | 1.37 | 1.34 | 1.28 | 1.27 |
| Analytes | $Pb^{2+}$ | $Al^{3+}$ | $Ca^{2+}$ | $Mn^{2+}$ | $In^{3+}$ | $Fe^{2+}$ | $Ni^{2+}$ | $Ga^{3+}$ | $Cr^{3+}$ | $Fe^{3+}$ |
| RLI value | 1.27 | 1.16 | 1.03 | 0.98 | 0.96 | 0.95 | 0.94 | 0.89 | 0.81 | 0.77 |

**Table S1.** The RLI values of different cations.

| Analytes | NX | 1,3-DNB | 1,4-DNB | 1,2-DNB | 3-NT |
|---|---|---|---|---|---|
| RLI value | 0.93 | 0.90 | 0.87 | 0.84 | 0.75 |
| Analytes | 4-NT | 2-NT | 3-NP | 2-NP | 4-NP |
| RLI value | 0.73 | 0.72 | 0.57 | 0.35 | 0.17 |

**Table S2.** The RLI values of different nitro explosives.

| Analytes | Etoxazole | Fluroxypyr | Acetamiprid | Isoxaflutole | Carbaryl |
|---|---|---|---|---|---|
| RLI value | 0.88 | 0.82 | 0.81 | 0.70 | 0.70 |
| Analytes | Carbendazim | Teflubenzuron | Thiamethoxam | Rotenone | Nitenpyram |
| RLI value | 0.68 | 0.67 | 0.67 | 0.38 | 0.18 |

**Table S3.** The RLI values of different pesticides.