Electronic Supplementary Information

AIEgen-Incorporated Nanoparticles as Probe for Construction of Dual-Luminophore Pressure and Temperature Sensitive Coatings

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1. Supplementary Figures

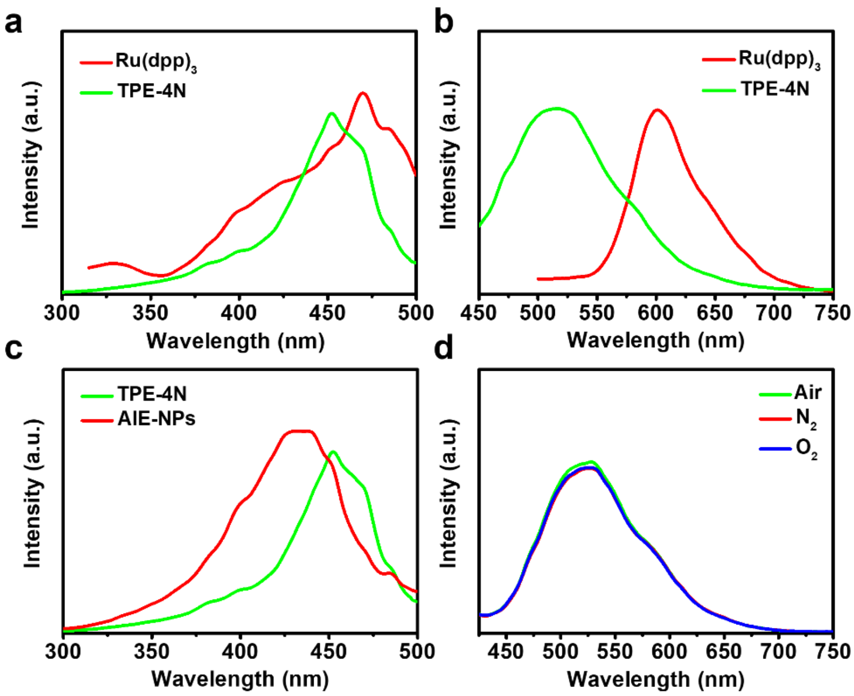

Figure S1. (a) Excitation spectra of TPE-4N powder and Ru(dpp)3. (b) Emission spectra of TPE-4N powder and Ru(dpp)3. (c) Excitation spectra of TPE-4N powder and AIE-NPs. (d) Emission spectra of TPE-4N powder with different gaseous environments.

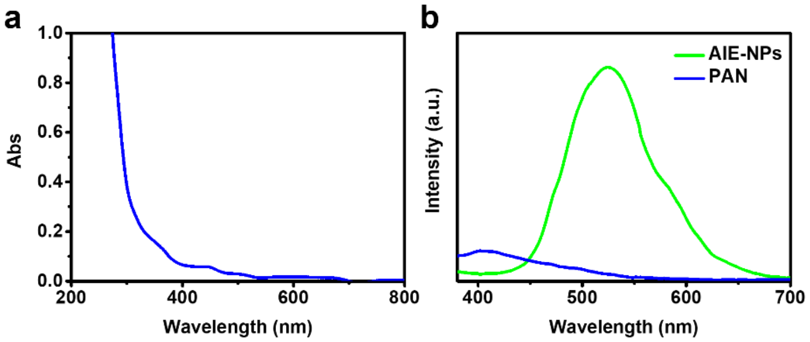

Figure S2. (a) Absorption spectrum of PAN. (b) Emission spectra of AIE-NPs and PAN under UV irradiation at 365 nm.

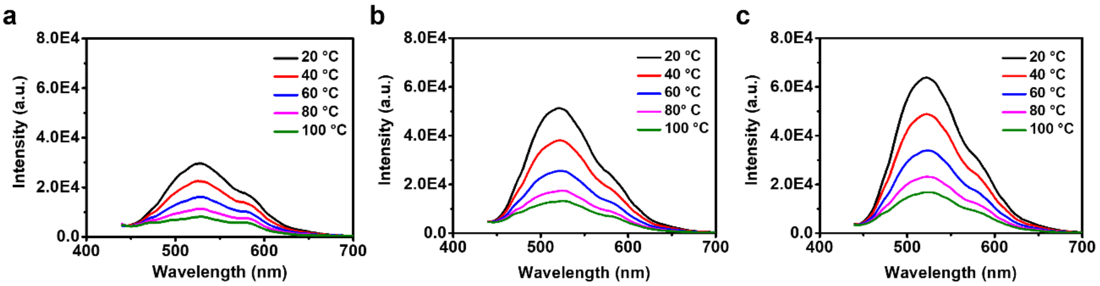

Figure S3. Fluorescence intensity of TPE-4N powder and AIE-NPs at different temperature from 20 °C to 100 °C. (a) TPE-4N powder. (b, c) AIE-NPs with mass ratio of TPE-4N to PAN of 1:20 (b) and 1:10 (w/w) (c).

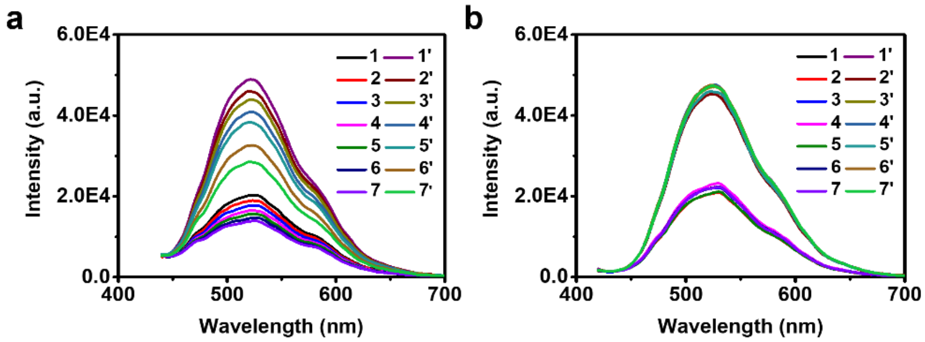

Figure S4. Cycles of heating and cooling between 80 °C (1 - 7) and 40 °C (1’ - 7’) on the fluorescence spectra of (a) TPE-4N powder and (b) AIE-NPs.

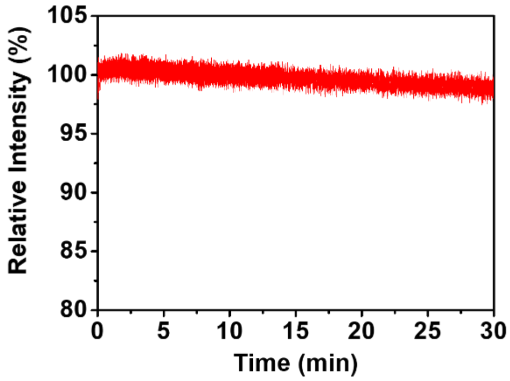

Figure S5. Time dependent emission intensity of Ru(dpp)3 in coating by recording the emission of the luminophore at 600 nm upon excitation at 365 nm.

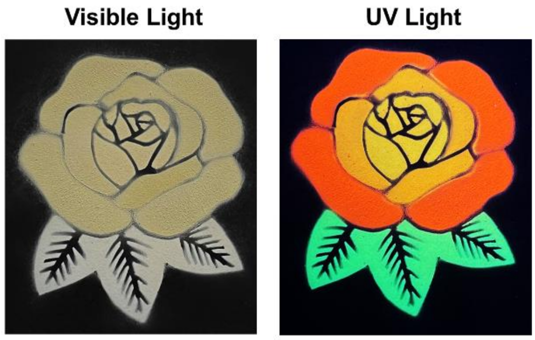

Figure S6. Sprayed patterns of a rose with dual-luminophore coating (flower) and AIE-NPs containing single luminophore coating (leaves) under visible and UV light.

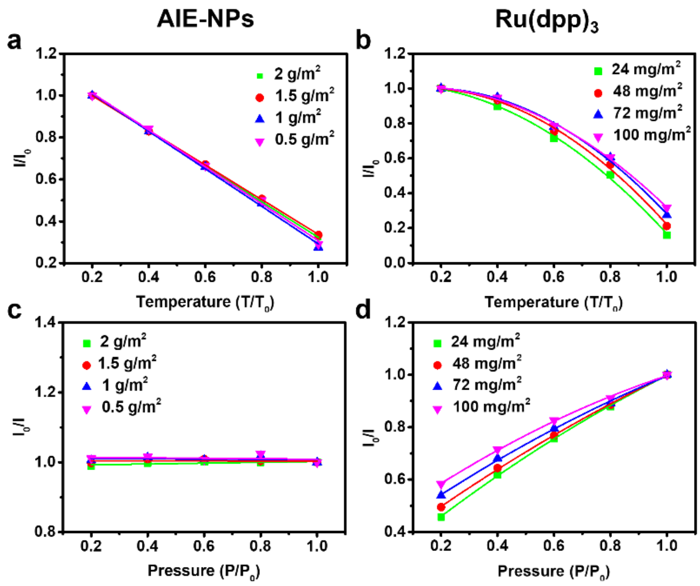

Figure S7. Influence of AIE-NPs and Ru(dpp)3 loading on temperature and pressure sensitivity of the dual-luminophore coatings.

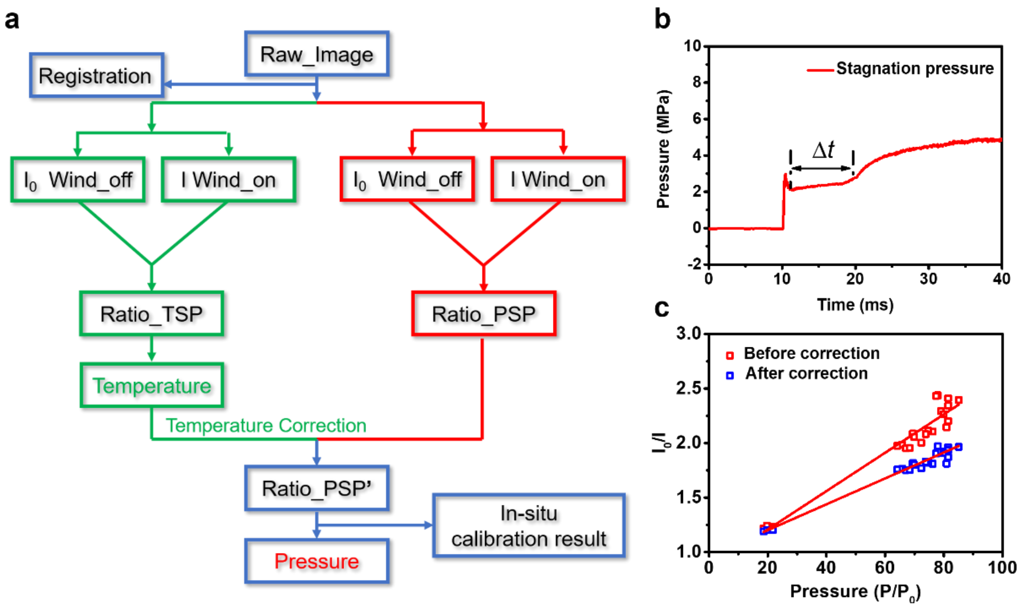

Figure S8. (a) Data processing procedures on images collected during aerodynamic test. (b) Effective test time of the case during wind tunnel running. (c) In situ calibration results of the case.

2. Pressure and Temperature Calibration

The relationship between pressure and luminescence intensity (I_1 and I_2 represent pressure and temperature sensitive luminophore respectively) can be expressed with the Stern-Volmer equation:

$$\frac{I_1\left(P_{\mathrm{ref}},T_{ref}\right)}{I_1\left(P,T_{ref}\right)}=A_0\left(T_{ref}\right)+A_1\left(T_{ref}\right)\frac{P}{P_{ref}} \tag{1}$$

where $A_0(T_{ref})$ and $A_1(T_{ref})$ are calibration coefficients, T_{ref} is reference temperature, 293 K, P_{ref} and P are the reference pressure (100 kPa) and measured pressure, respectively.

The calibration equation for the temperature is as follows:

$$\frac{I\left(P_{ref},T\right)}{I\left(P_{ref},T_{ref}\right)}=\left\{\left\{B_0\left(P_{ref}\right)+B_1\left(P_{ref}\right)\exp\left(-\frac{B_2\left(P_{ref}\right)}{T}\right)\right\}\right\}^{-1} \tag{2}$$

where B_0, B_1 and B_2 are calibration coefficients. According to the static calibration data, the relationship between temperature and luminescence intensity of Ru(dpp)$_3$ and AIE-NPs could be fitted with a quadratic fit curve and a liner curve as follows respectively:

$$\frac{I_1\left(P_{ref},T_1\right)}{I_1\left(P_{ref},T_{ref}\right)}=B_{10}+B_{11}\frac{T_1}{T_{ref}}+B_{12}\left(\frac{T_1}{T_{ref}}\right)^2 \tag{3}$$

$$\frac{I_2\left(P_{ref},T_2\right)}{I_2\left(P_{ref},T_{ref}\right)}=B_{20}+B_{21}\frac{T_2}{T_{ref}} \tag{4}$$

3. Temperature Correction

According to the calibration results, in practice, the pressure values were calculated from the luminescence intensity at each measurement and reference state derived from Eq. 1 as follows:

$$P=P_{ref}\frac{I_1\left(P_{ref},T_{ref}\right)/I_1\left(P,T_{ref}\right)-A_0\left(T_{ref}\right)}{A_1\left(T_{ref}\right)} \tag{5}$$

The sample temperature values were determined from the luminescence intensities of AIE-NP according to the following equation derived from Eq. 4:

$$T_2=T_{ref}\left[\frac{I_2\left(P_{ref},T\right)/I_2\left(P_{ref},T_{ref}\right)-B_{20}}{B_{21}}\right] \tag{6}$$

The corrected luminescence intensity values, $I_1\left(P_{ref},T_1\right)$, were determined from

$$\frac{I_1\left(P_{ref},T_1\right)}{I_1\left(P,T\right)}=\frac{I_1\left(P_{ref},T_1\right)}{I_1\left(P_{ref},T_{ref}\right)}\times\frac{I_1\left(P_{ref},T_{ref}\right)}{I_1\left(P,T\right)} \tag{7}$$

where the $I_1(P,T)$ and $I_1(P_{ref},T_{ref})$ represent the luminescence intensity of reference state and intensity change caused by the combined effect of temperature and pressure.

Here we used the temperature dependence of the Ru(dpp)$_3$ luminescence intensities based on static calibration derived from Eq. 3 as follows:

$$T_1 = T_{ref}\left[\frac{-B_{11}+\sqrt{B_{11}^2-4B_{12}\left(B_{10}-I_1\left(P_{ref},T\right)/I_1\left(P_{ref},T_{ref}\right)\right)}}{2B_{12}}\right] \quad (8)$$

For dual luminophore coating, the temperature of T_1 equals to T_2. Using the corrected luminescence intensity values obtained from Eq. 7 and Eq. 8, the pressure values after the temperature corrections were eventually calculated as follows:

$$P = P_{ref}\frac{I_1\left(P_{ref},T_1\right)/I_1\left(P,T\right)-A_0\left(T_{ref}\right)}{A_1\left(T_{ref}\right)} \quad (9)$$

4. Supplementary Table

Table S1. Conditions for the wind channel test

	Ma	P_0 (MPa)	T_0 (K)	P_∞ (Pa)	T_∞ (K)	ρ_∞ (kg/m^3)	u_∞ (m/s)	Re_∞ (10e^7/m)
Case	6.5	2.51	600	1066	65	0.056	1036	1.4