Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Activating room-temperature phosphorescence of 1,8-naphthalimide by doping into aromatic dicarboxylic acid

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Contents

1. Experimental details

UV-visible absorption spectra were obtained using Perkin Elmer Lambda35. Steady-state fluorescence/phosphorescence spectra and excitation spectra were measured using Hitachi F-4600. The lifetimes and time-resolved emission spectra were carried out on the Edinburgh FLSP 920 fluorescence spectrophotometer equipped with a xenon arc lamp (Xe 900) and microsecond flash-lamp (μF 900), respectively. Photoluminescence quantum efficiency was measured by an integrating sphere on a Hamamatsu Absolute PL Quantum Yield Spectrometer C11347 under ambient condition. The phosphorescence efficiencies of all compounds were obtained following the equation of

$$\Phi_{phos} = B/A \times \Phi_{PL} \quad (1)$$

Where A and B represent the integral area of total photoluminescence and phosphorescence spectra, respectively. The phosphorescence was separated from the total photoluminescence (PL) spectrum based on the phosphorescence spectrum for phosphorescence quantum yields.[1] Φ_{PL} represents the absolute photoluminescence quantum yields of compounds in solid-state. Luminescence photos and videos were taken by Cannon EOS 800D single lens digital cameras with a hand-held UV-lamp on and off.

Material synthesis. Materials unless other mentioned, all the materials used in the experiments, including 1,8-naphthalimide(**NI**), phthalic acid (**PA**), isophthalic acid (**IPA**), and terephthalic acid (**TPA**), were purified by recrystallization for three times to prevent impurities caused luminescence, and all other solvents were purchased from commercial source.

NI-based organic afterglow composites: The **NI**-based composites including **NI@PA** (**NI** dispersed in **PA**), **NI@IPA** (**NI** dispersed in **IPA**), and **NI@IPA** (**NI** dispersed in **TPA**) were prepared in a standard procedure. Take **NI@PA** as an example. Firstly, 1.97 mg **NI** was dissolved in 4.5 mL MeCN to afford a 0.44 mg/mL solution of **NI**. Secondly, 8.30 g crystals of **PA** was added, followed the addition of 6 mL deionized water and 18 mL ethanol. Thirdly, the mixture was heated to 85 °C and keeping for 45 min. Finally, the solvents were removed under reduced pressure and the obtained solid mixture was dried by under vacuum at 60 °C for 24 h to get the composite of **NI@PA** crystal with **NI** content of 0.02 mol%. **NI@IPA**, **NI@TPA** was prepared following the same procedure as **NI@PA**.

The detail for the security protection application. The screen printing process was adopted for patterning. The ink based on ground **NI@PA**, **NI@IPA** or **NI@TPA** powder was firstly prepared with aloe vera gel. Then the ink was printed onto a piece of filter paper. After dry treatment for 30 minutes, a pattern with UOP feature was obtained.

2. Supporting Figures and Tables

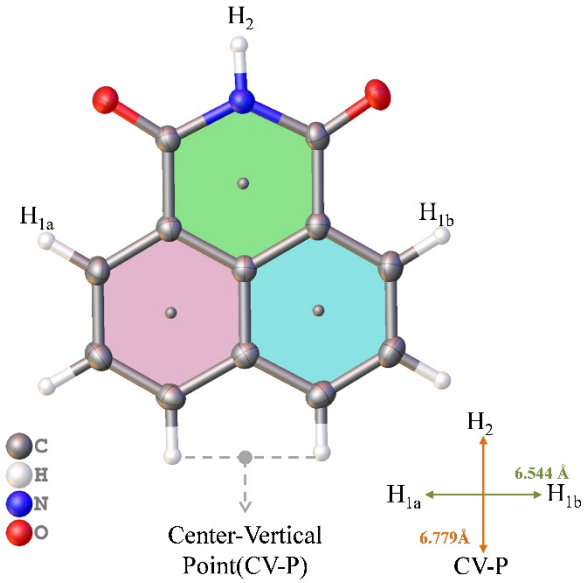

Fig. S1 The **NI** molecular geometry.

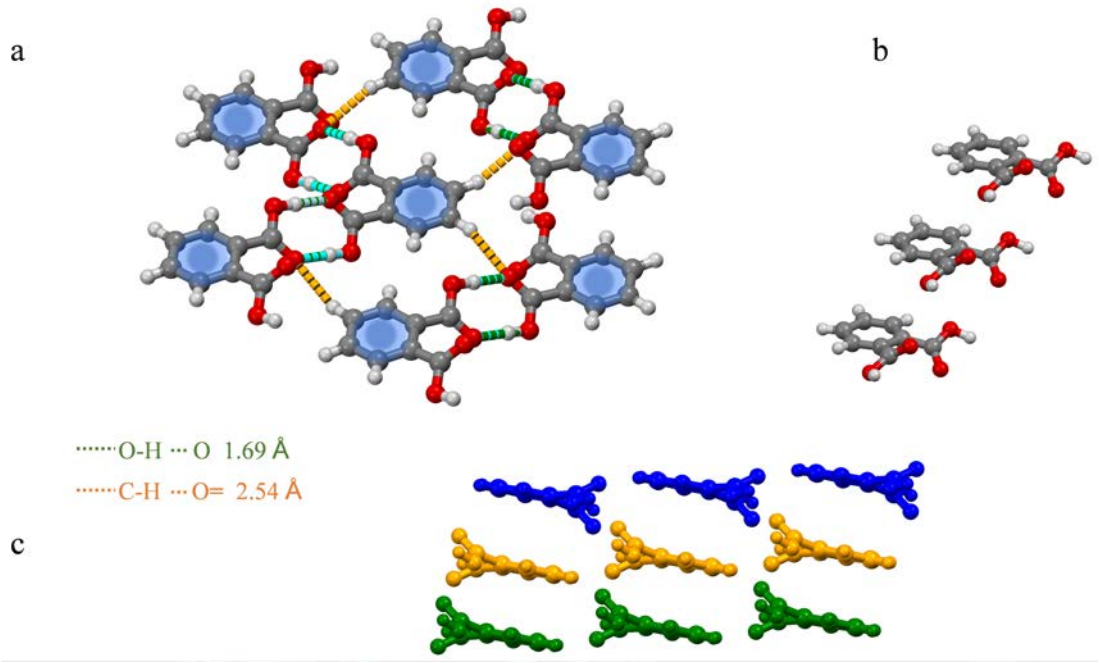

Fig. S2 (a) Intermolecular interaction of **PA**. (b) The interlayer structure of **PA**. (c) The packing

arrangement of pure **PA**.

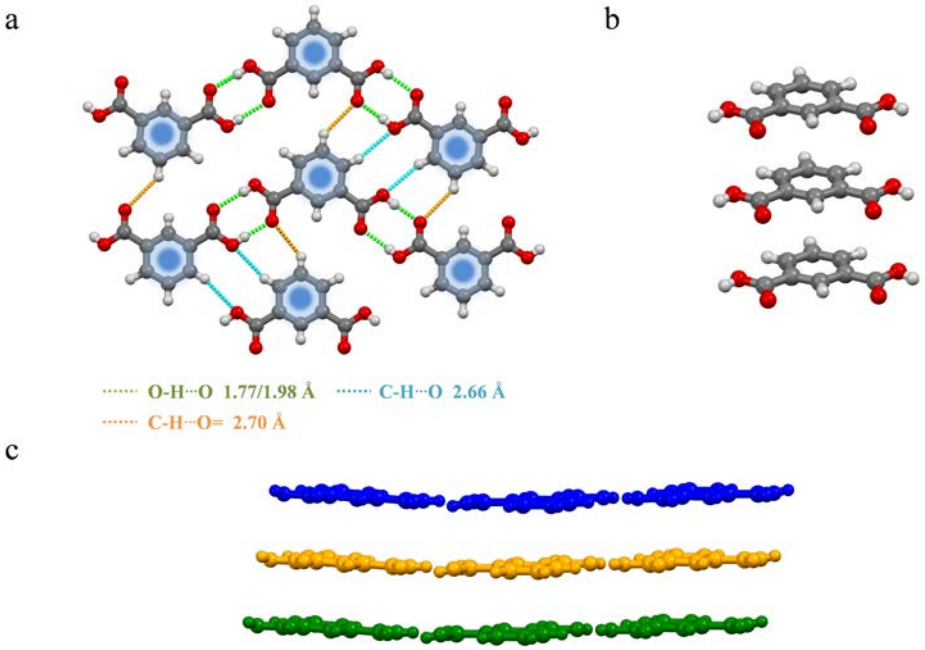

Fig. S3 (a) The interlayer structure of **IPA**. (b) Intermolecular interaction of **IPA**. (c) The packing arrangement of pure **IPA**.

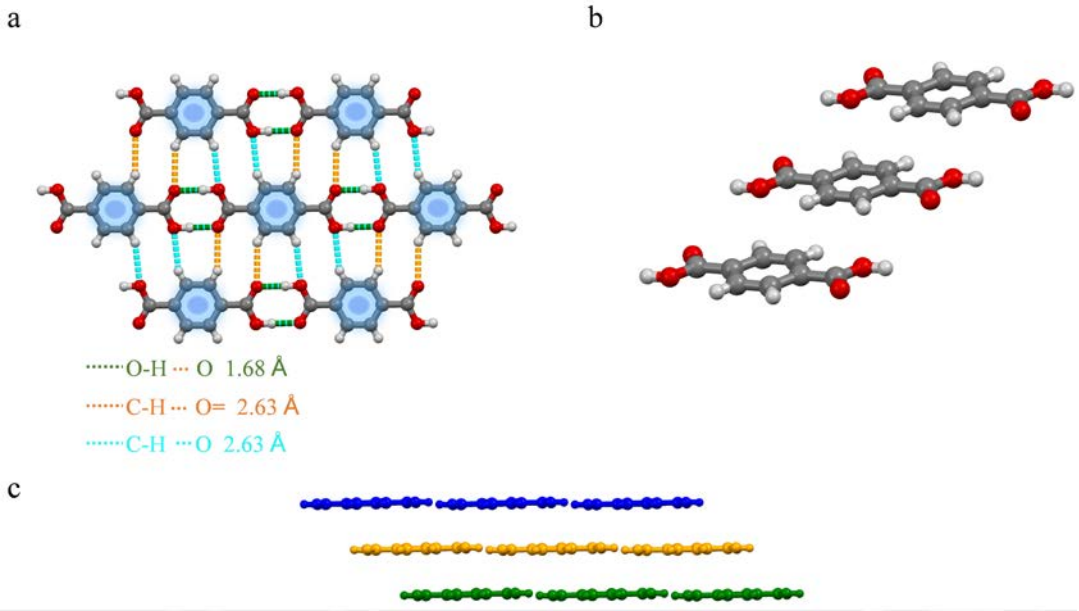

Fig. S4 (a) Intermolecular interaction of **TPA**. (b) The interlayer structure of **TPA**. (c) The packing arrangement of pure **TPA**.

Crystal structures of guest (**NI**) and host (**PA**, **IPA** and **TPA**) and their packing modes. All the

crystal structure data were downloaded at the Cambridge Crystallographic Data Centre. (CCDC numbers: 146947 (**NI**), 1232671 (**PA**), 1108748 (**IPA**), 1854403 (**TPA**)).

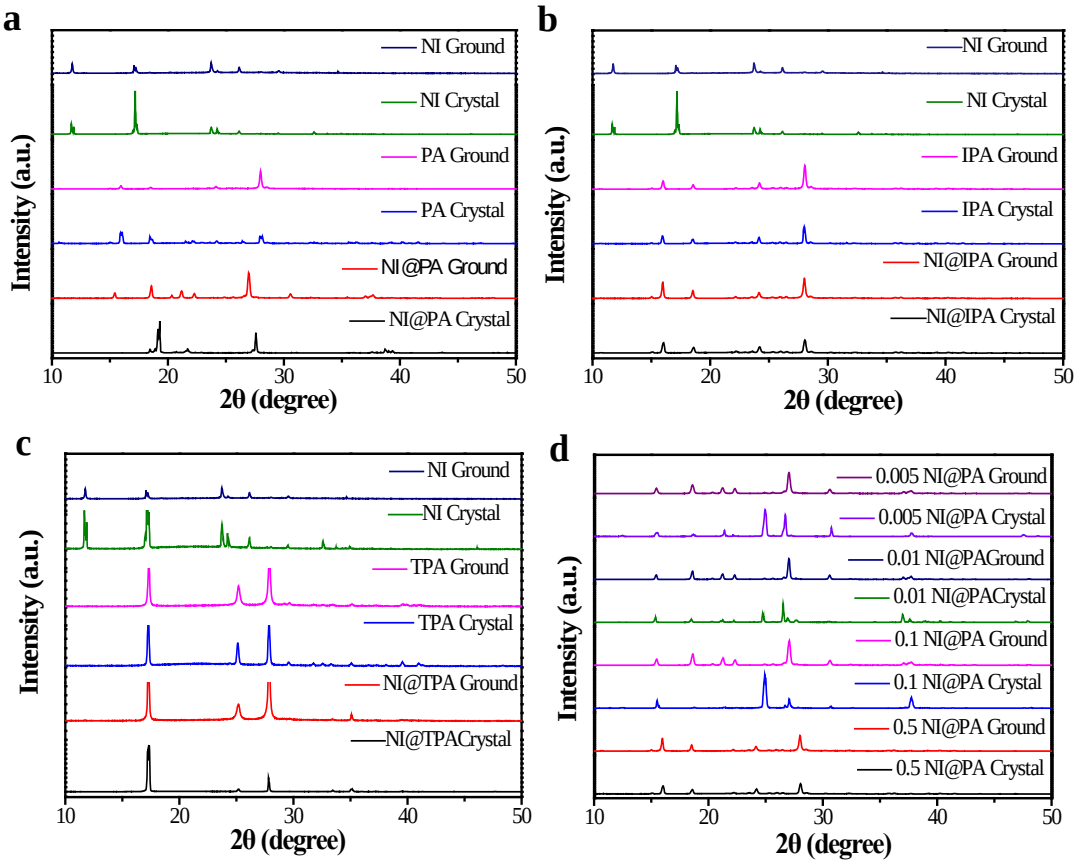

Fig. S5 (a-c) Powder X-ray diffraction (PXRD) patterns of the doping material (**NI@PA**, **NI@IPA** and **NI@TPA**) and the corresponding individual host (**PA**, **IPA** and **TPA**) and guest (**NI**) component. (d) Powder X-ray diffraction (PXRD) pattern of **NI@PA** with varied concentration.

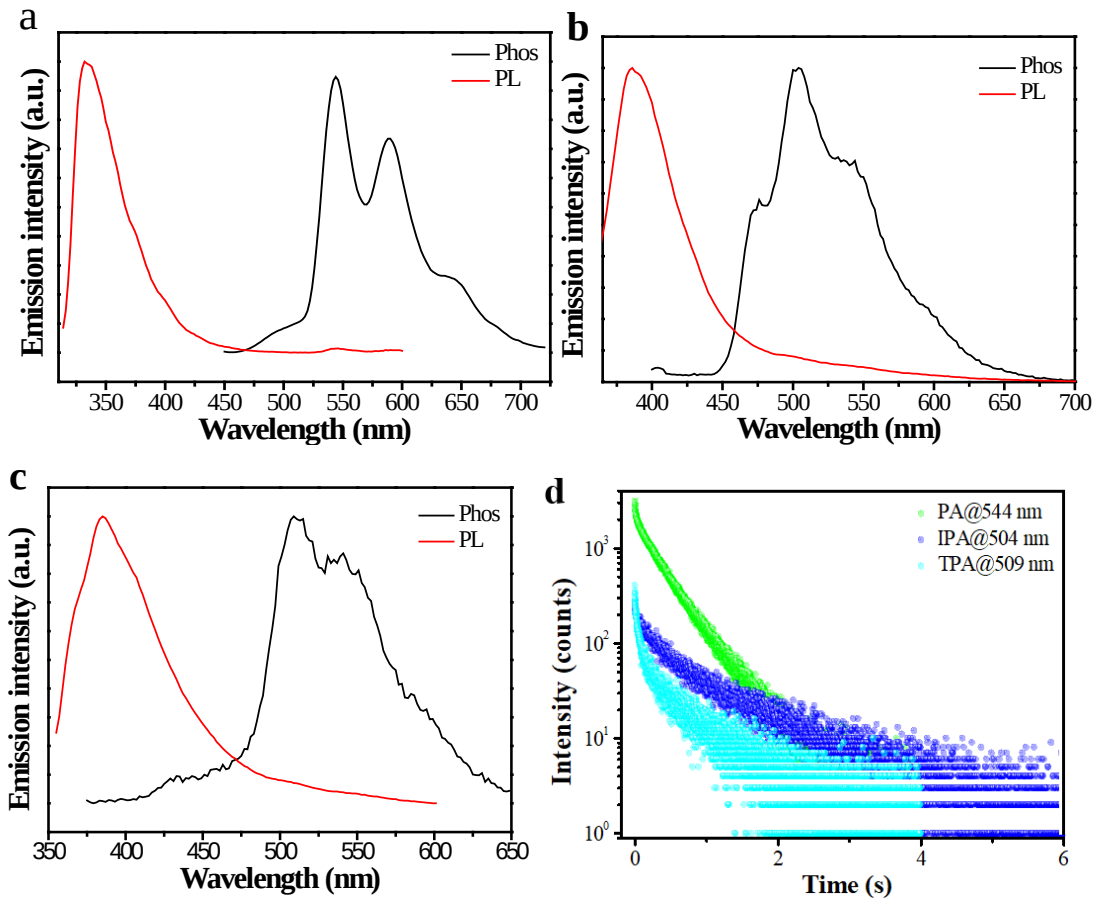

Fig. S6 Luminescent properties of the host molecules. (a-c) steady-state photoluminescence (PL) spectrum, phosphorescence spectra of **PA**,**IPA** and **TPA** crystals at ambient conditions. (d) Time-resolved PL decay curves of **PA** at 544 nm, **IPA** at 504 nm, and **TPA** crystals at 509 nm (delayed time: 5 ms).

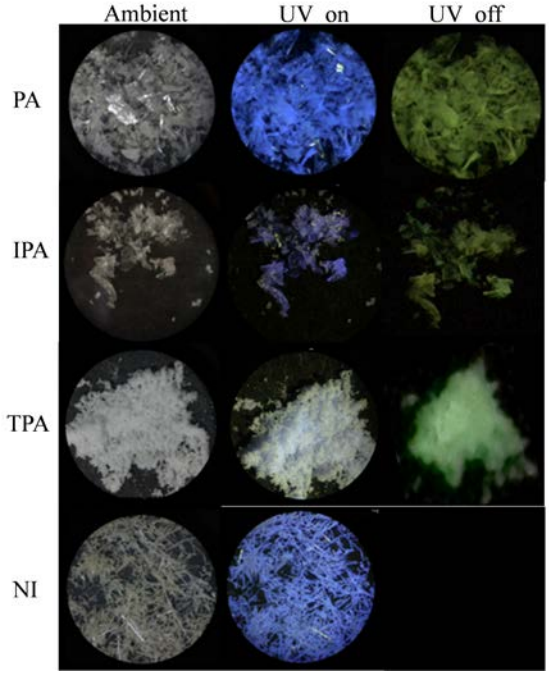

Fig. S7 Photos of **PA**, **IPA**, **TPA** and **NI** crystals under 365 nm UV light irradiation and after the UV irradiation ceased under ambient conditions.

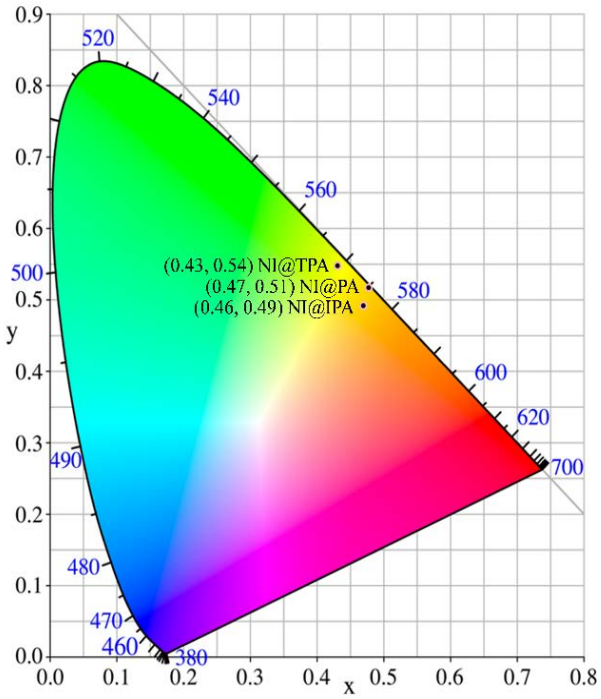

Fig. S8 CIE 1931 coordinates of phosphorescence emission of **NI@PA**, **NI@IPA** and **NI@TPA**. (0.02 mol %).

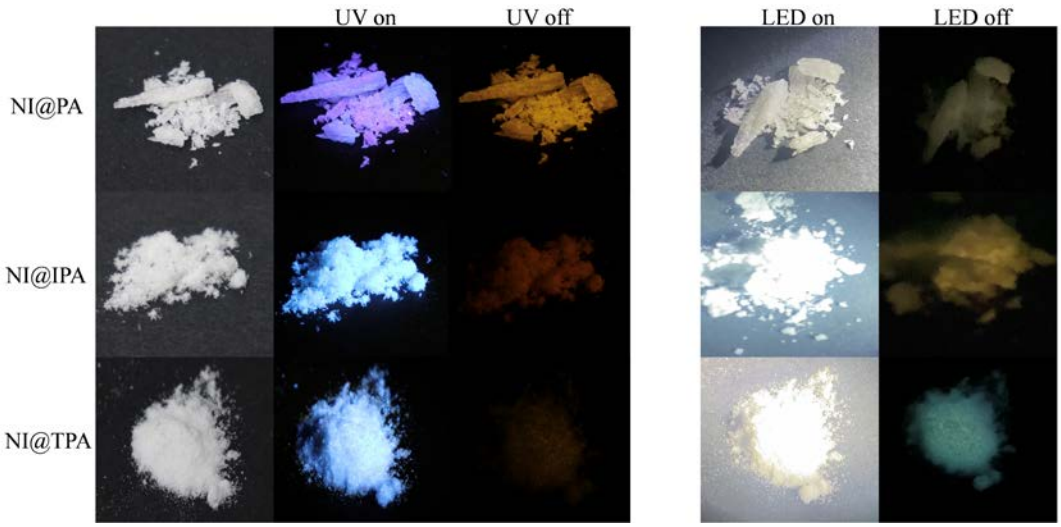

Fig. S9 Photographs of **NI@PA**, **NI@IPA** and **NI@TPA** upon excitation by UV and LED and removal of light source.

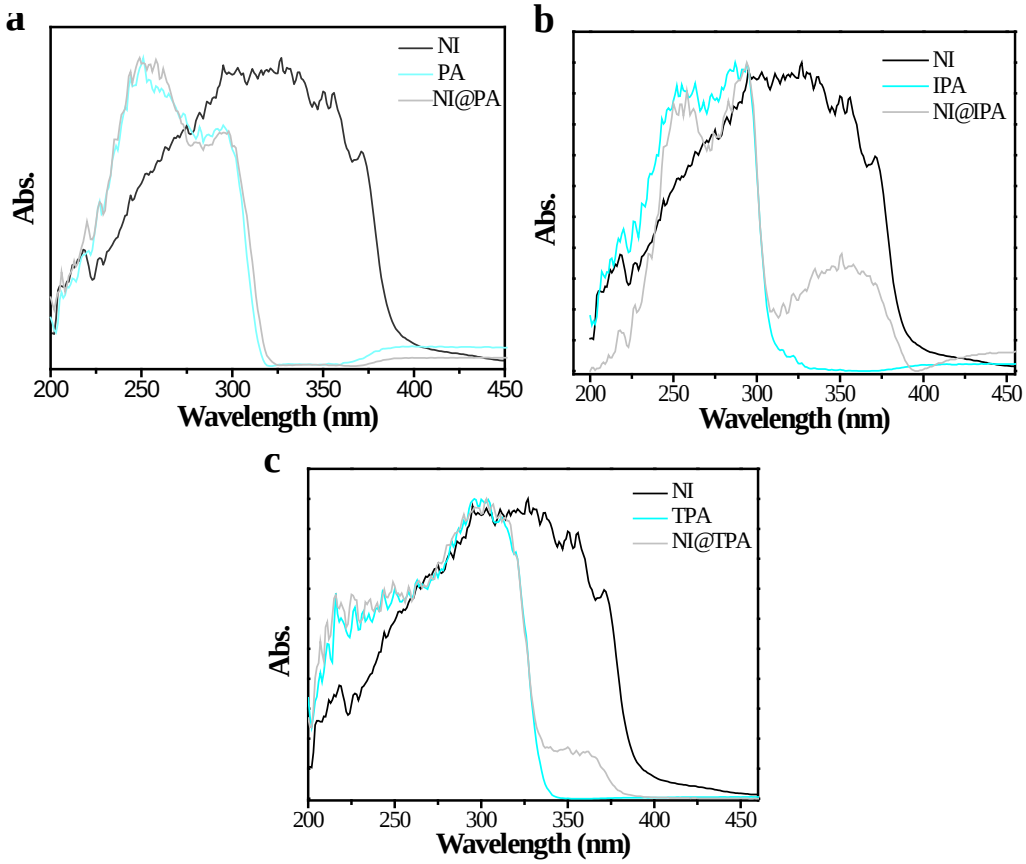

Fig. S10 The absorption spectra of guest, host and host-guest doping system in the solid state.

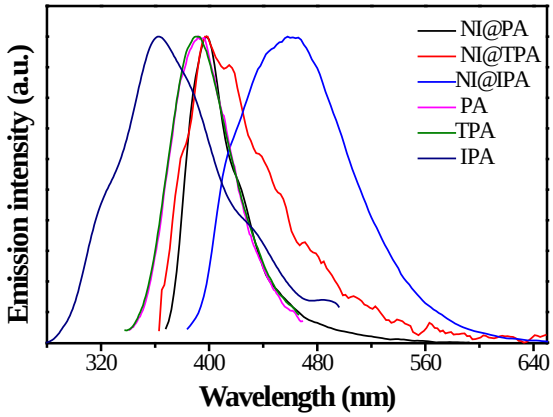

Fig. S11 The fluorescence spectra of the **PA**, **IPA**, **TPA**, **NI@PA**, **NI@IPA** and **NI@TPA** crystals.

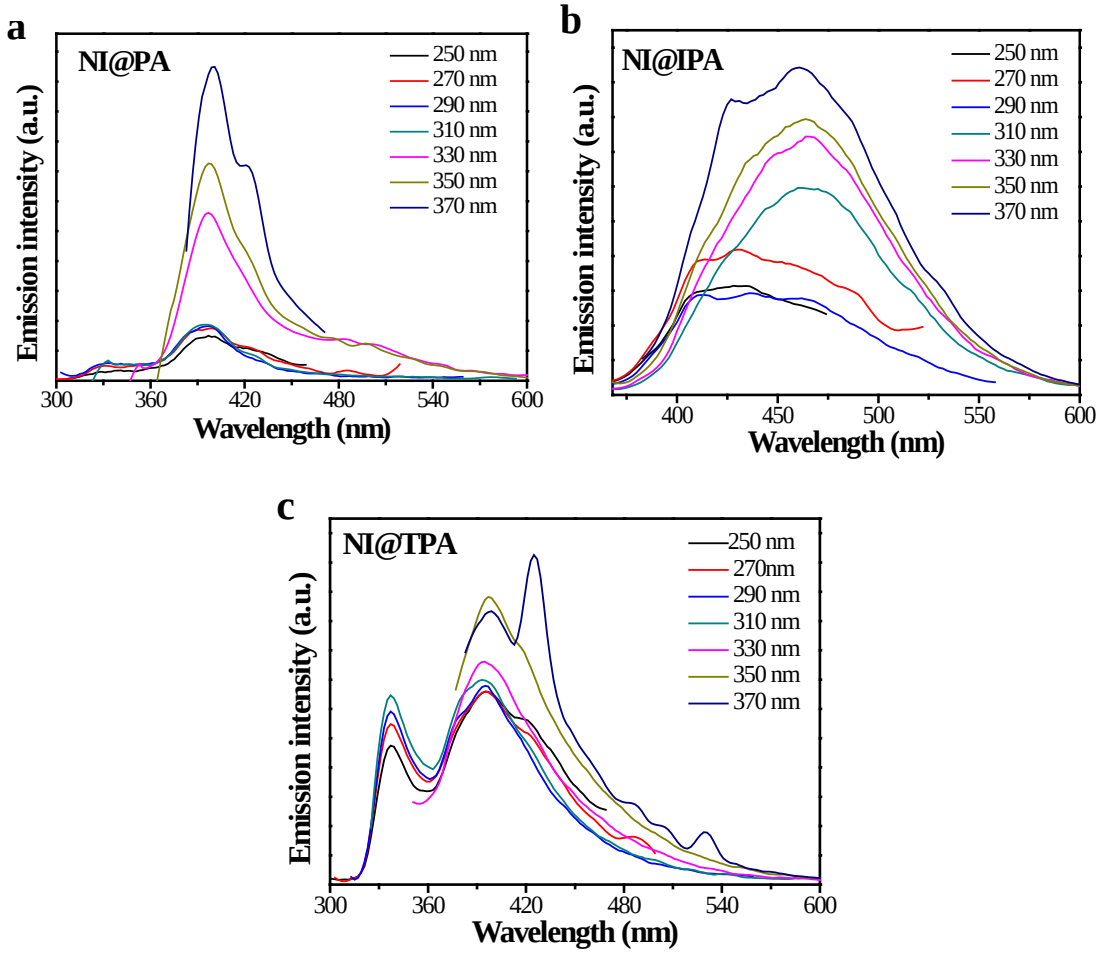

Fig. S12 (a-c) Fluorescence spectra of **NI@IPA**, **NI@PA** and **NI@TPA** at various excitation wavelengths at room temperature.

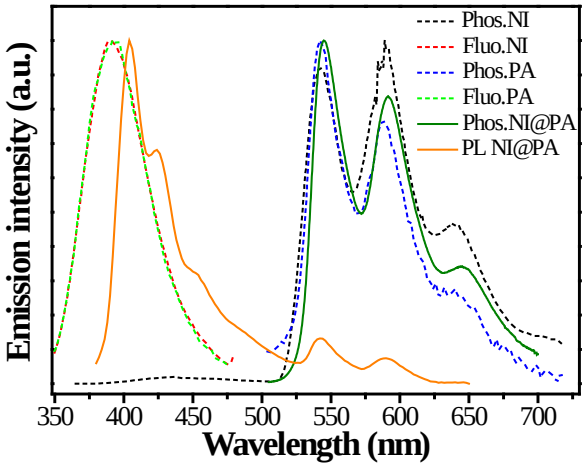

Fig. S13 Steady state PL spectra of **NI** dopants in **PA** at 298 K (orange solid line, λ_{ex}=300 nm); fluorescence spectra of **NI** (red dashed line) and **PA** (green dashed line); phosphorescence spectra of **NI** at 77 K (black dashed line), **PA** at 298 K (blue dashed line) and **NI@PA** at 298 K (green solid line).

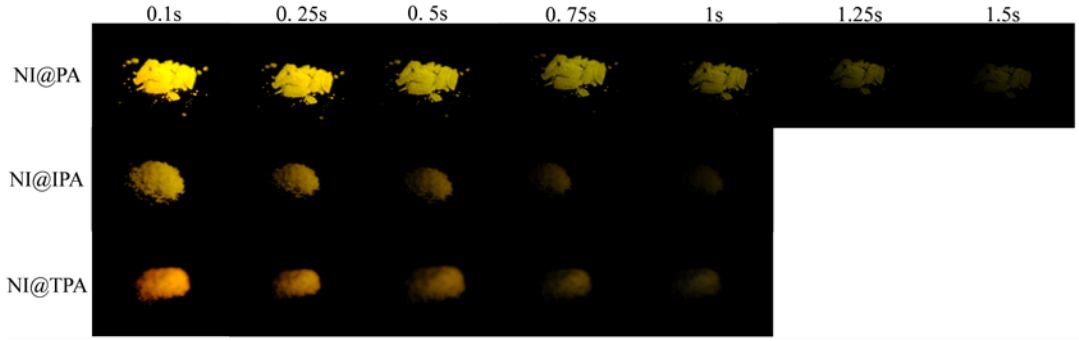

Fig. S14 The RTP behaviors of the **NI@PA**, **NI@IPA** and **NI@TPA** doping Materials.

Table S1. Photoluminescence lifetime (τ) of **NI**, **PA**, **IPA**, **TPA**, **NI@PA**, **NI@IPA** and **NI@TPA** crystals.

	Wavelength (nm)	**Phosphorescence**					
		$\tau_{1\ (ms)}$	A_1(%)	$\tau_{2\ (ms)}$	A_2(%)	$\tau_{3\ (ms)}$	A_3(%)
NI							
PA	544	100	9.06	402.16	90.94		
IPA	504	44.63	0.83	304.43	24.64	1169.45	74.53
TPA	509	53.20	19.99	556.46	80.01		
NI@PA	544	100.00	2.34	420.95	97.66		
NI@IPA	557	100.00	7.82	390.48	92.18		
NI@TPA	547	341.11	100				

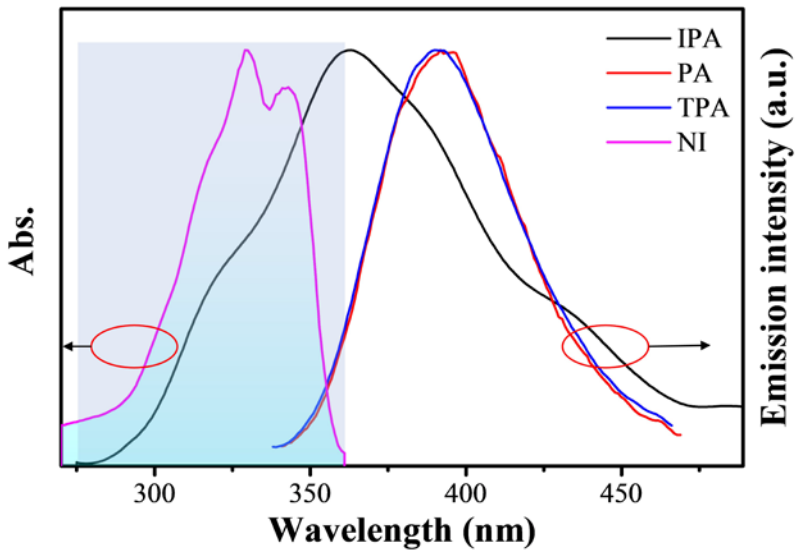

Fig. S15 Absorption spectra of **NI** and fluorescence emission spectra of **PA**, **IPA** and **TPA** in THF (1 x 10^{-5} M) at 298 K. The blue box highlights the spectral overlap between the emission of host (**PA**, **IPA** and **TPA**) and the absorption of the guest (**NI**).