Supplementary Information (SI) for Journal of Materials Chemistry C.
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Supplementary Information

Table S1 The comparison of common RTP materials

	Type	Wavelength range	Lifetime range	QY range	Morphology	Remarks
Inorganic	Metal Ion (Rare earth or transient metal)	420-1300 nm	6 s-18 day (Afterglow)	-	Mostly crystal	Ultralong lifetime; good photostability; sensitive to moisture; requirement of activators; poor machinability[1-3]
	Inorganic cluster (fullerene etc.)	700 nm ($Mo_6I_8^4$), >700 nm ($Re_6Se_8^5$), 800 nm (Fullerene[6])	0.002-0.189 ms	1.5-53%	Nanocluster	Good photostability and biocompatible[1-3]

	Inorganic quantum dots	1045-1130 nm (ClSe quantum dots[7, 8])	0.186-0.336 ms	12.4-42.7%	Nanodot, Nanotube	–
Organic	Organic molecule	Visible light to NIR I	Microsecond - sub second level (afterglow: 7h by trap states)	<52.1%	Crystal, solution, thin film, powder and aggregate	Relatively poor photostability; sensitive to oxygen; tunable wavelength; low QY[1, 9-13]
	Polymer & supramolecule	Visible light to NIR I	Microsecond - second level	<76%	Thim film, cocrystal and cluster	Good photostability; tunable wavelength; higher QY and longer lifetime than organic molecules[1, 13-17]
Inorganic-Organic hybrid materials	Metal organic complex	Visible light to NIR I	Sub microsecond - millisecond level	Up to near-unity	Crystal, solution, thin film, powder and aggregate	Easy to process; high QY; relatively poor photostability; short lifetime suitable for OLED[1, 18, 19]

	Metal organic framework	Bule to NIR	Microsecond - second level	<80.6%	Nanocrystal	Thermal and photo stability, long lifetime and high QY, stimulus responsive phosphorescence[1, 20, 21]
	Organic-inorganic metal halides	Green, Yellow, Red, NIR	Microsecond - millisecond level	Up to near-unity	Crystal and thin film	Thermal and photo stability; sensitive to moisture; high QY[1, 22, 23]
	Carbon Dots	Ultraviolet to NIR I	Microsecond - second level (afterglow: hour level by trap states)	Most <50%	Nanodots	Thermal and photo stability; long lifetime; relatively low QY; biocompatible; low toxic; cheap[1, 24, 25]

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