Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary Information

Thermal Enhanced NIR Up-conversion Fluorescence Multimode Thermometry Based on $Y_2Mo_3O_{12}$: Nd^{3+}, Yb^{3+}

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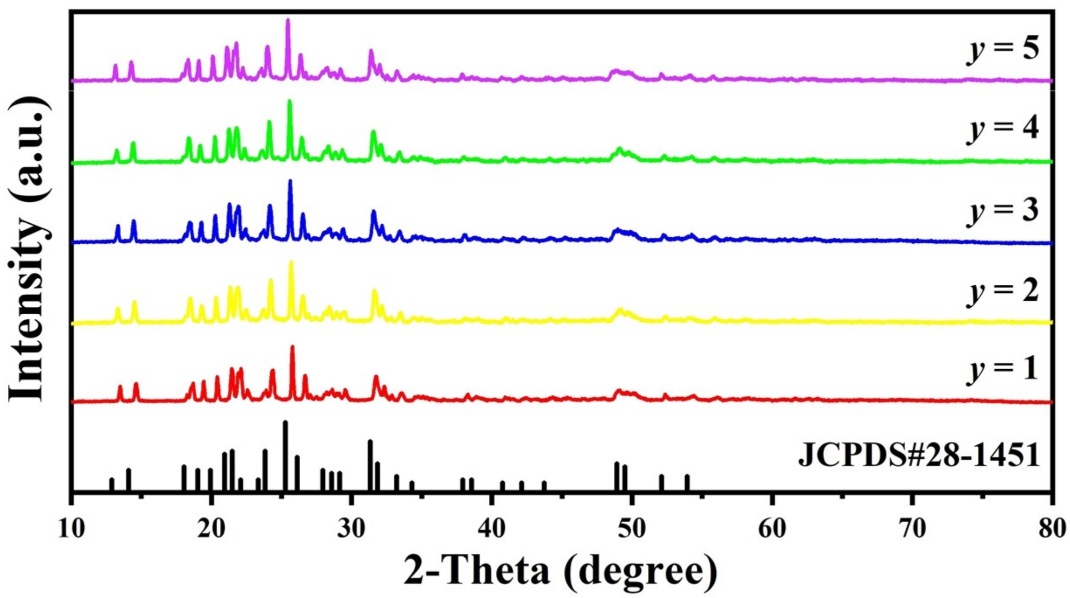

Fig. S1. XRD patterns of $Y_2Mo_3O_{12}$: 1%Nd^{3+}, *y*%Yb^{3+} as function of Yb^{3+} concentration.

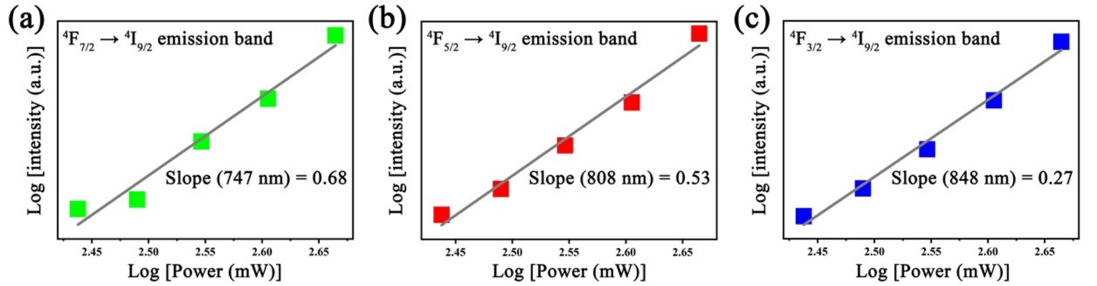

Fig. S2. Dual logarithmic plots of UC emission integral intensities of (a) $^4F_{7/2} \rightarrow {}^4I_{9/2}$, (b) $^4F_{5/2} \rightarrow {}^4I_{9/2}$ and (c) $^4F_{3/2} \rightarrow {}^4I_{9/2}$ emission band *versus* pump power.

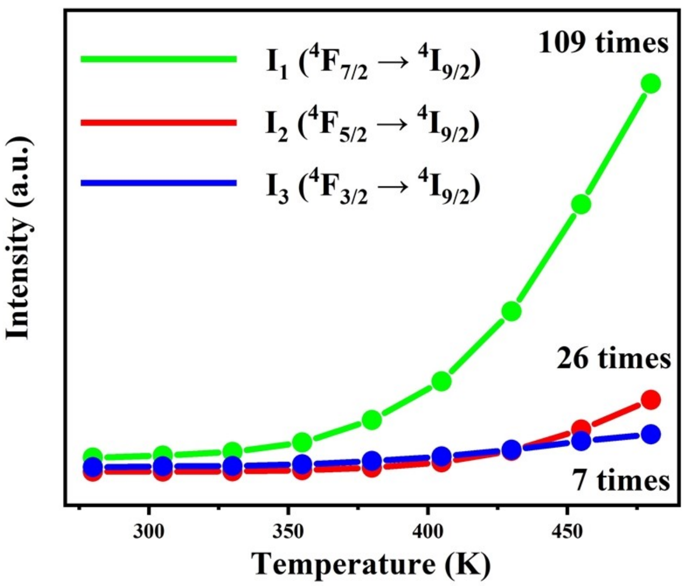

Fig. S3. Temperature-dependent UC emission intensity records of ladder-like TCLs of Nd^{3+}.

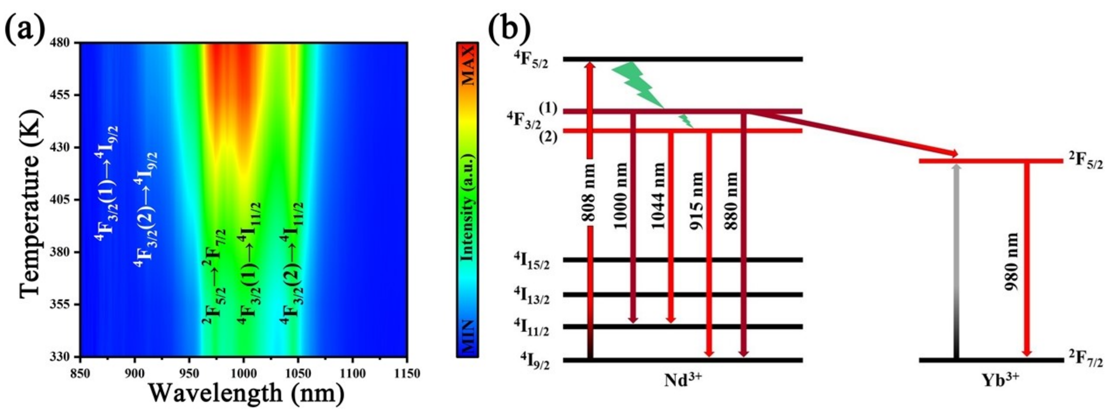

Fig. S4. (a) Temperature-dependent DC spectra and (b) possible DC processes of $Y_2Mo_3O_{12}$: 1%Nd^{3+}, 5%Yb^{3+} under 808 nm laser excitation.

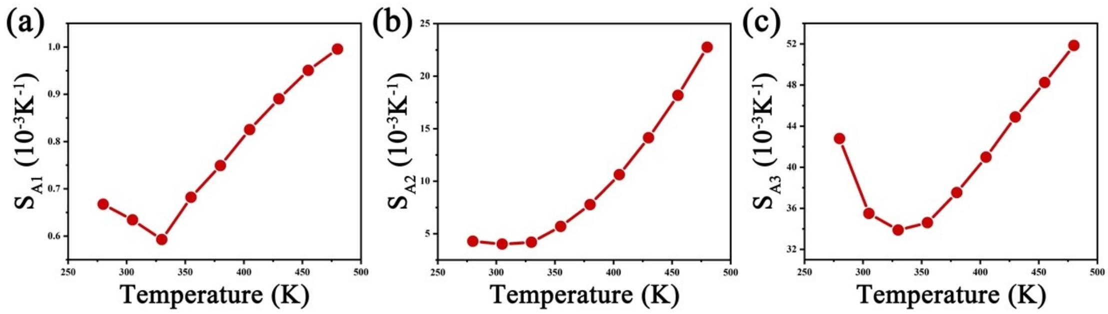

Fig. S5. S_A of (a) FIR_1, (b) FIR_2 and (c) FIR_3.

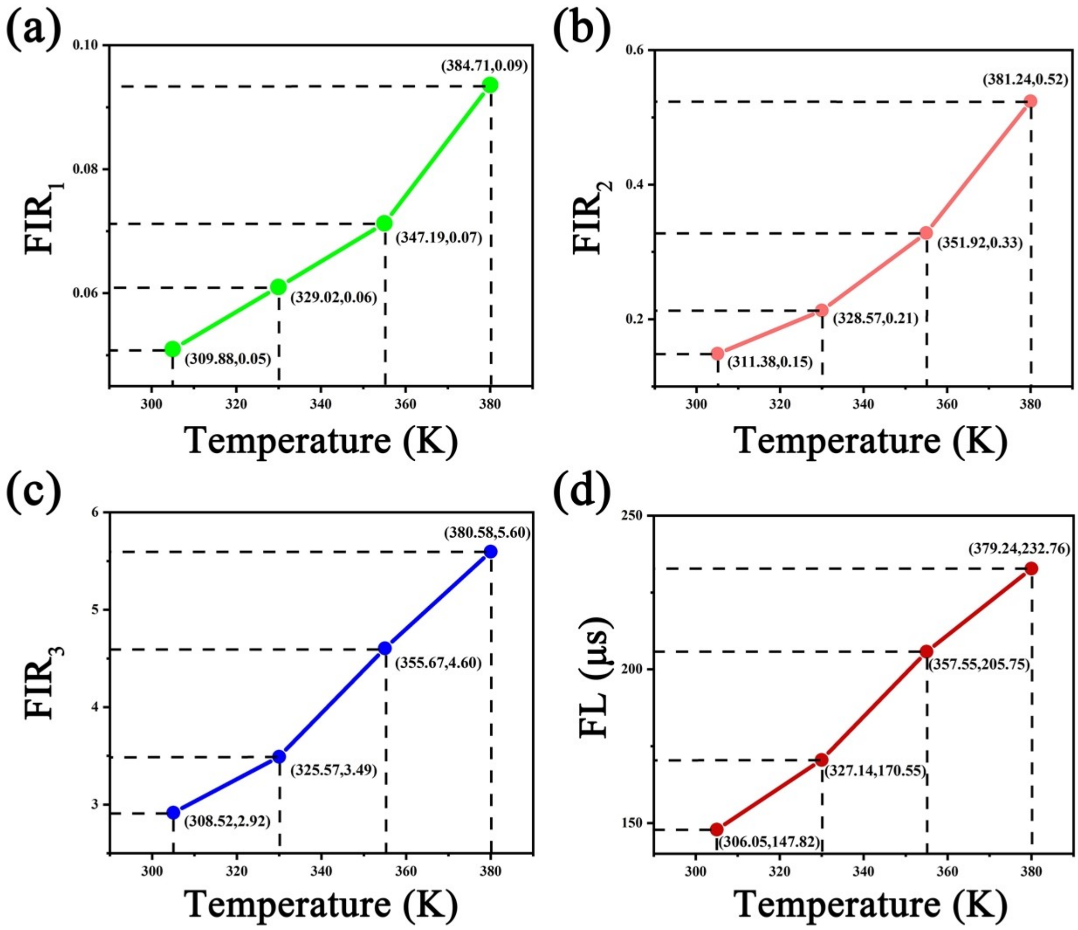

Fig. S6. Temperature readouts comparisons calculated from (a-c) three kinds of FIR thermometers and fitting curves and (d) FL thermometer and fitting curve.

Table S1. Rietveld XRD refinement results of the blank and doped samples

Sample	Blank	Doped
Formula	$Y_2Mo_3O_{12}$	$Y_2Mo_3O_{12}$: 1%Nd^{3+}, 5%Yb^{3+}
Crystal system	Orthorhombic	Orthorhombic
Space group	*Pbcn*	*Pbcn*
Lattice parameter (a)	13.60 Å	13.59 Å
Lattice parameter (b)	9.94 Å	9.92 Å
Lattice parameter (c)	9.97 Å	9.97 Å
Lattice volume (V)	1347.78 Å^3	1344.08 Å^3
Lattice parameter (α, β, γ)	α = β = γ = 90°	α = β = γ = 90°
Reliability (R_p)	8.02%	7.62%
Reliability (R_{wp})	10.28%	9.78%
Reliability (χ^2)	2.088	1.879

Table S2. Comparison of S_R among the reported FIR thermometers.

Materials	λ_{ex} (nm)	Emissions	S_R (K^{-1})	ref
CaF_2:Nd^{3+}/Y^{3+}	808	$^4F_{3/2} \rightarrow {}^4I_{11/2}$	0.18%	[1]
$LiLuF_4$:Nd^{3+}	808	$^4F_{3/2} \rightarrow {}^4I_{9/2}$	0.62%	[2]
$CaWO_4$:Nd^{3+}	350/275	$^4F_{3/2} \rightarrow {}^4I_{11/2}$	0.94%	[3]
La_2O_3:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{5/2} \rightarrow {}^4I_{9/2}$	1.60%	[4]
$NaYF_4$:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	2.35%	[5]
$CaWO_4$:Yb^{3+}/Nd^{3+}/Li^+	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	2.59%	[6]
$Ba_4La_2Ti_4Nb_6O_{30}$:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	3.07%	[7]
$SrWO_4$:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	3.11%	[8]
$Bi_4Ti_3O_{12}$:Yb^{3+}/ Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	3.20%	[9]
$NaY(MoO_4)_2$:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$	3.28%	[10]
$Y_2Mo_3O_{12}$:Yb^{3+}/Nd^{3+}	980	$^4F_{7/2}$, $^4F_{3/2} \rightarrow {}^4I_{9/2}$ $^4F_{5/2} \rightarrow {}^4I_{9/2}$ (FL)	3.49% 2.13%	**This work**

Table S3. Calculation results of δT among the four kinds of thermometers.

T (K)	δT (FIR_1)	δT (FIR_2)	δT (FIR_3)	T (K)	δT (FL)
280	2.89 K	1.12 K	0.57 K	**280**	2.32 K
480	1.16 K	0.61 K	0.65 K	**380**	1.78 K

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