Supporting Information

Upconversion-mediated Boltzmann Thermometry in Double-Layered $Bi_2SiO_5:Yb^{3+},Tm^{3+}@SiO_2$ Hollow Nanoparticles

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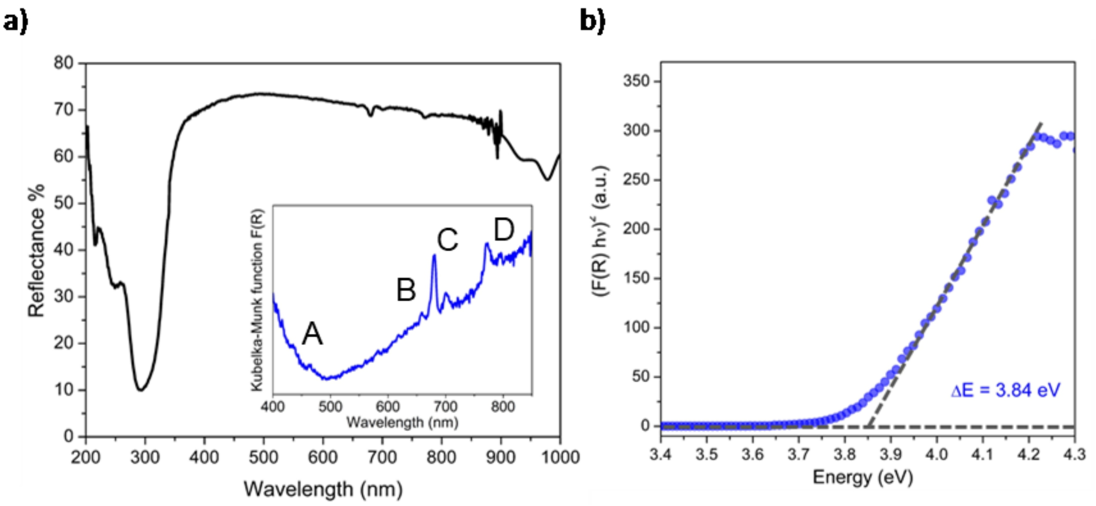

Figure S1. (a) Diffuse reflectance spectra, of Yb,Tm co-doped Bi_2SiO_5@SiO_2 NPs, respectively, with the Kubelka–Munk function (inset) and (b) bandgap estimation as the intercept of the fitted straight line at F(R)=0 in the $(F(R)\cdot h\nu)^2$ versus hν plot. Capital letters represent the transitions of Tm^{3+} (A: $^3F_4\rightarrow{}^1D_2$, $^3H_6\rightarrow{}^1G_4$, B: $^3F_4\rightarrow{}^1G_4$, C: $^3H_6\rightarrow{}^3F_{2,3}$, D: $^3H_6\rightarrow{}^3H_4$).

Table S1. Absolute and relative sensitivity (S_a and S_r) at 300 K for a series of Tm^{3+} and Nd^{3+} activated thermometers based on the Boltzmann law**.**

Compound	S_r **(%K⁻¹)**	S_a **(K⁻¹)**	**Ref.**
	Tm^{3+}		
Bi_2SiO_5	1.95	$1.7\cdot10^{-2}$	This work
Sr_2GdF_7 (GC)[a]	1.45	$9.7\cdot10^{-4}$	[1]
YF_3 (GC)	0.18	$2.2\cdot10^{-4}$	[2]
$NaYF_4$	0.42	$3.8\cdot10^{-3}$	[3]
YVO_4 ($^3F_3$-$^1G_4$)	0.85	$1.4\cdot10^{-3}$	[4]
YVO_4 ($^3F_{2,3}$-$^3H_4$)	1.81	$6.6\cdot10^{-4}$	[4]
$Y_{4.67}Si_3O_{13}$	2.28	$4.1\cdot10^{-5}$	[5]
PbF_2 (GC)	0.26	$4.6\cdot10^{-5}$	[6]
$LaPO_4$	2.86	$2.1\cdot10^{-5}$	[7]
YPO_4	2.23	$4.2\cdot10^{-5}$	[7]
$NaYF_4$	0.09	$2.4\cdot10^{-5}$	[8]

$LiNbO_3$	0.054	$2.5 \cdot 10^{-6}$	[9]
Oxyfluoride GC	0.049	$7.0 \cdot 10^{-6}$	[10]
$YAlO_3$ (325 K)	2.62	$2.4 \cdot 10^{-5}$	[11]
YF_3:Yb5,Tm	1.48	$4.2 \cdot 10^{-5}$	[12]
YF_3:Yb40,Tm	0.30	$4.1 \cdot 10^{-5}$	[12]
$NaLuF_4$	2.65	$3.6 \cdot 10^{-5}$	[13]
$YAlO_3$	1.875	$1.3 \cdot 10^{-4}$	[14]
$SrWO_4$ ($^3F_2$)	0.69	$5.4 \cdot 10^{-3}$	[15]
$SrWO_4$ ($^3F_3$)	0.73	$6.1 \cdot 10^{-3}$	[15]
	Nd^{3+}		
Gd_2O_3	1.42	$4 \cdot 10^{-4}$	[16]
$NaYF_4$ (Z)[b]	0.096	$8 \cdot 10^{-4}$	[17]
LaF_3 (Z)	0.085	$4.6 \cdot 10^{-4}$	[18]
YAG (Z)	0.15	$1.2 \cdot 10^{-3}$	[19]
$YNbO_4$ (Z)	0.28	$1.5 \cdot 10^{-3}$	[20]
$LaGaO_3$	1.6	$3 \cdot 10^{-4}$	[21]
CaF_2:Y,Nd (Z)	0.13	$1.4 \cdot 10^{-3}$	[22]

[a] (GC): Glass Ceramic

[b] (Z): Thermometer based on the $^4F_{3/2}$ Stark levels (Z_1-Z_2)

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