

Supplementary Materials

Luminescence Properties of an Orthorhombic KLaF₄ Phosphor Doped with Pr³⁺ Ions under Vacuum Ultraviolet and Visible Excitation

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Table S1. Lattice parameters and unit cell volume of KLaF₄:Pr³⁺ nanoparticles.

	<i>a</i> (Å)	<i>b</i> (Å)	<i>c</i> (Å)	<i>V</i> (Å ³)
KLaF ₄	6.3299	3.8509	15.6801	382.21
KLaF ₄ :0.1%Pr ³⁺	6.3290	3.8509	15.6799	382.15
KLaF ₄ :0.5%Pr ³⁺	6.3285	3.8506	15.6755	381.98
KLaF ₄ :1%Pr ³⁺	6.3232	3.8501	15.6723	381.54
KLaF ₄ :1.5%Pr ³⁺	6.3228	3.8499	15.6699	381.44
KLaF ₄ :2%Pr ³⁺	6.3227	3.8498	15.6696	381.41

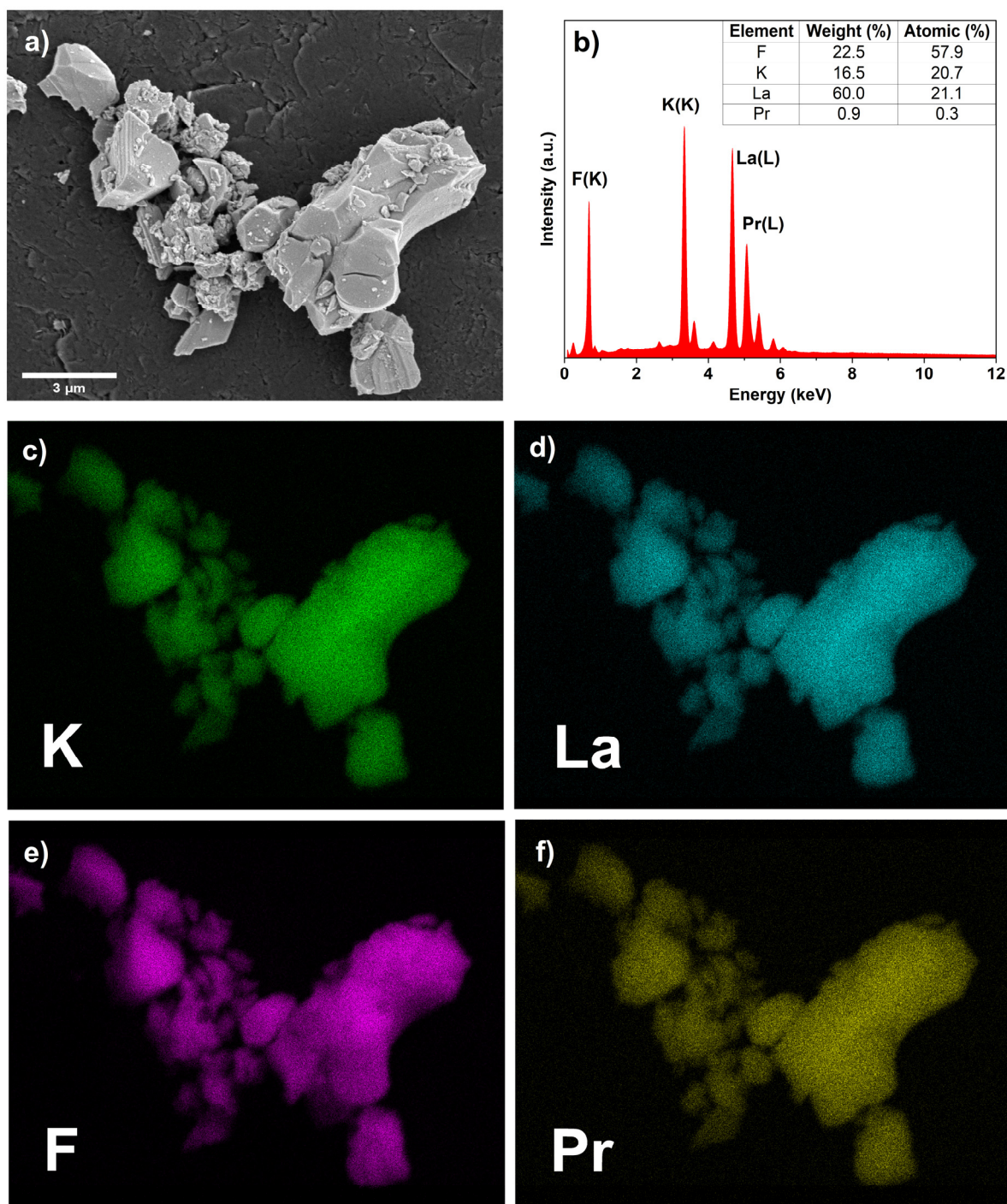


Figure S1. a) SEM image of analyzed grain. b) EDS spectrum of $\text{KLaF}_4:1.5\%\text{Pr}^{3+}$ sample; inset shows weight and atomic percentage of elements in the matrix. c-f) EDS element mapping.

Table S2. Information about bands observed in the excitation and emission spectra of KLaF₄:1%Pr³⁺ measured in the UV range.

Excitation				
Transition	E (cm ⁻¹)	λ (nm)	FWHM (cm ⁻¹)	Peak number
$^3H_4 \rightarrow 4f^5d^1$	52880	189	3486	1
	55872	179	5291	2
	60480	165	2808	3
	62408	160	2177	4
	64472	155	4177	5
Emission				
Transition	E (cm ⁻¹)	λ (nm)	FWHM (cm ⁻¹)	β_{ex} [%]
$^1S_0 \rightarrow ^3H_4$	46189	216	1177	3.8
$^1S_0 \rightarrow ^3H_6$	42463	236	1140	1.8
$^1S_0 \rightarrow ^3F_3$	39761	252	845	17.8
$^1S_0 \rightarrow ^1G_4$	36630	273	742	25.8
$^1S_0 \rightarrow ^1D_2$	29630	338	615	10.9
$^1S_0 \rightarrow ^1I_6$	24661	406	776	39.8
$^3P_0 \rightarrow ^3H_4$	20640	484	315	

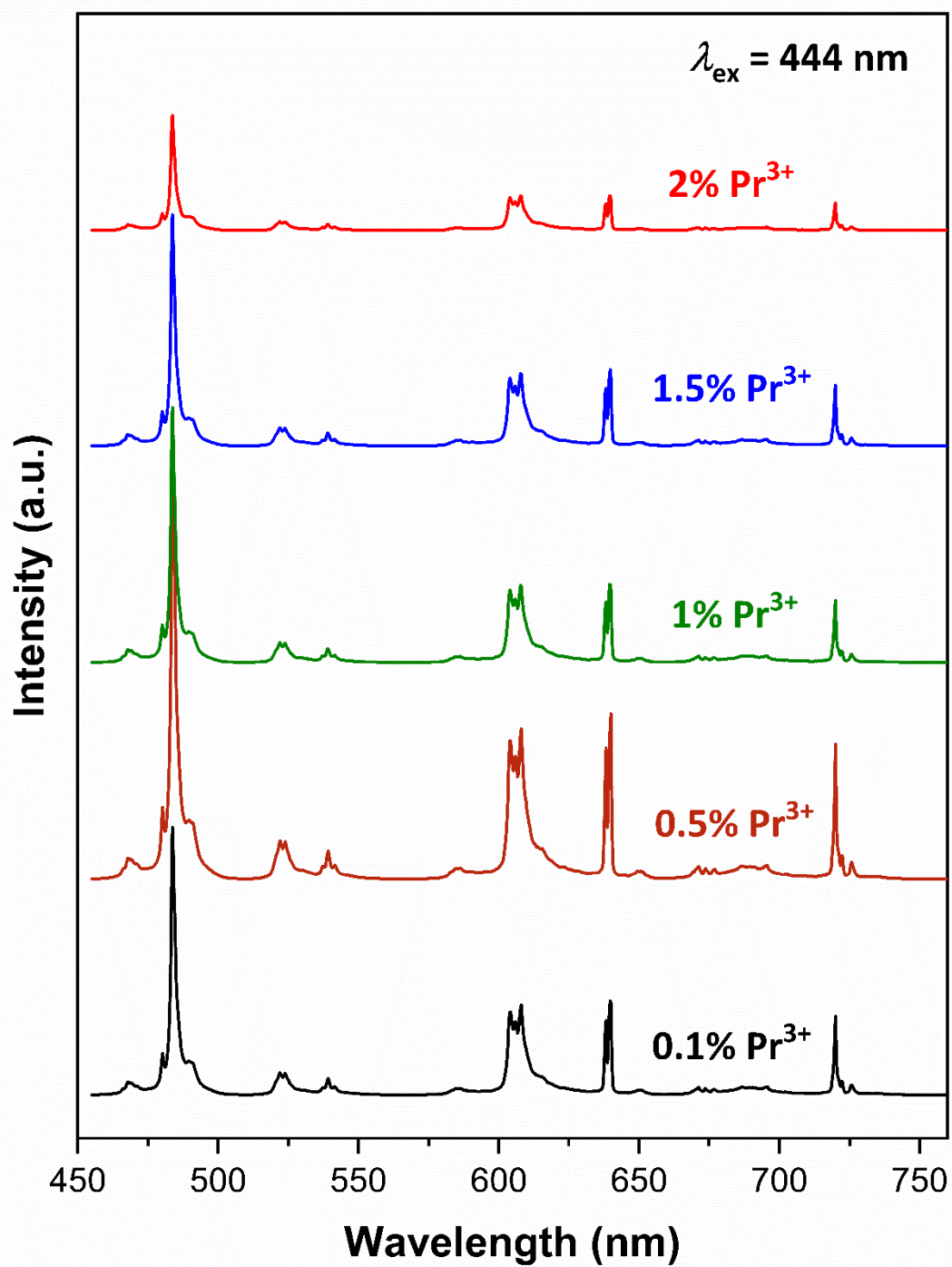


Figure S2. Emission spectra of KLaF₄ doped with different Pr³⁺ ion concentrations, measured under 444 nm excitation.

Table S3. Experimental energies of Pr³⁺ Stark levels in KLaF₄ host.

$^{2S+1}L_J$	Experimental Stark-levels energy (cm ⁻¹)	Experimental number of levels	Theoretical number of levels
³ H ₄	0, 114, 147, 186, 222	5	9
³ H ₅	2208, 2271, 2361	3	11
³ H ₆	4275, 4321, 4374, 4425, 4457	5	13
³ F ₂	5143, 5146, 5175, 5188	5	5
³ F ₃	6410, 6432, 6454, 6509, 6570, 6581*	6	7
³ F ₄	6915, 6921, 6923, 6943, 6969	5	9
¹ G ₄	9694*	1	9
¹ D ₂	16775*	1	5
³ P ₀	20809	1	1
³ P ₁	21352, 21411, 21431	3	3
³ P ₂	22506, 22524, 22586, 22597	2	5
¹ S ₀	46387*	1	1

* Energies calculated based on the room temperature emission spectra (**Error! Reference source not found.**b and 5b).

Table S4. Comparison of the maximum relative temperature sensitivities ($S_{R\text{ MAX}}$ at given T_{MAX}) of different Ln^{3+} -based luminescence thermometers working in the low-temperature range.

Host	Dopant	T_{MAX} [K]	$S_{R\text{ MAX}}$ (%K ⁻¹)	Reference
KLaF ₄	Pr ³⁺	140	1.70	This work
β -NaYF ₄	Pr ³⁺	120	≈ 5	[1]
Y ₂ O ₃	Nd ³⁺	123	1.51	[2]
NaYF ₄	Nd ³⁺	203	16.3	[3]
fluoroindate glass	Er ³⁺	152	2.8	[4]
NaGdF ₄	Yb ³⁺	125	≈ 1.2	[5]
La ₂ MgTiO ₆	Cr ³⁺ , V ⁴⁺	165	1.96	[6]
[GA]Mn(HCOO) ₃	Cr ³⁺	100	1.20	[7]
(Me ₂ NH ₂) ₃ [Eu ₃ (FDC) ₄ (NO ₃) ₄] \cdot 4H ₂ O	Eu ³⁺	170	2.7	[8]

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