# Understanding the Temperature-Dependent Luminescence of $LiLuF_4:Pr^{3+}$ for Emerging Applications

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Among the diverse classes of $Pr^{3+}$ doped optical materials, fluoride crystals remain at the forefront of interest due to their high ionicity and exceptionally wide band gaps. $LiLuF_4$, in particular, serves as an ideal host matrix owing to its low phonon cutoff energy and proven stability for high-temperature applications [1].

In this work, we report on the hydrothermally synthesized of tetragonal $LiLuF_4:Pr^{3+}$. We characterize its morphology and present detailed luminescence spectra recorded over the extensive temperature range of 5–1100 K. Under excitation at 444.1 nm ($^3H_4 \rightarrow {}^3P_2$ transition), the obtained material exhibits intense visible emissions originating from the $^3P_J \rightarrow {}^3H_J$ and $^1D_2 \rightarrow {}^3H_J$ manifolds.

Our discussion focuses on the thermally induced evolution of photoluminescence, specifically on the redistribution of Stark level populations within the $^1D_2$ state. Furthermore, we analyze spectral variations at elevated temperatures, driven by shifts in the Boltzmann distribution between $Pr^{3+}$ electronic levels. Finally, we evaluate the $LiLuF_4$:Pr material as a candidate for emerging applications.

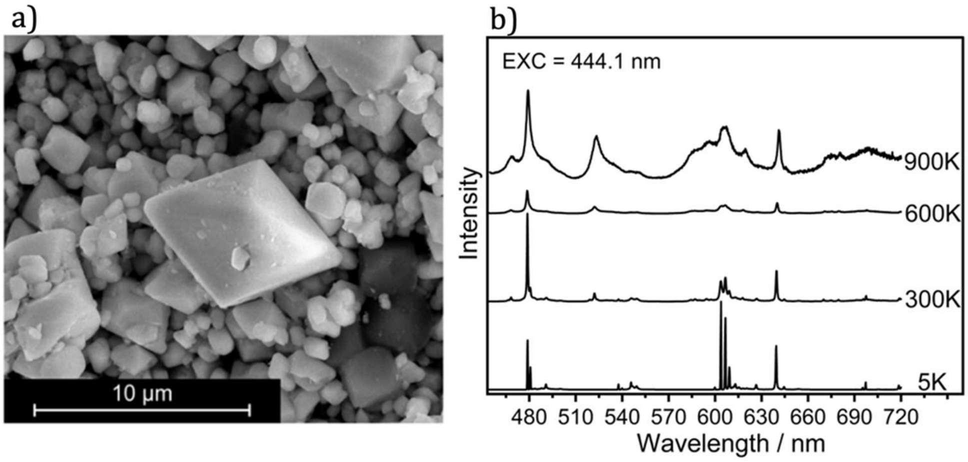


Fig. 1. Typical SEM image (a) and emission spectra collected under 444.1 nm excitation at selected temperatures (b) for $LiLuF_4:0.5Pr^{3+}$.

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[1] Lederer M. et all (2025) J. Mater. Chem. C, 13, 22315–22325

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