

Emission properties of Tm^{3+} -doped CaF_2 ,
 KY_3F_{10} , LiYF_4 , LiLuF_4 and BaY_2F_8 crystals at
1.5 μm and 2.3 μm

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Abstract: Thulium ions (Tm^{3+}) are known for their emissions in the near- and mid-infrared spectral ranges suitable for efficient laser operation. We systematically study the stimulated-emission cross-sections σ_{SE} for the ${}^3\text{H}_4 \rightarrow {}^3\text{F}_4$ (at $\sim 1.5 \mu\text{m}$) and ${}^3\text{H}_4 \rightarrow {}^3\text{H}_5$ (at $\sim 2.3 \mu\text{m}$) Tm^{3+} transitions in five low-phonon energy fluoride single-crystals, namely, cubic $\text{Tm}:\text{CaF}_2$ and $\text{Tm}:\text{KY}_3\text{F}_{10}$, tetragonal $\text{Tm}:\text{LiYF}_4$ and $\text{Tm}:\text{LiLuF}_4$ and monoclinic $\text{Tm}:\text{BaY}_2\text{F}_8$. A promising material is $\text{Tm}:\text{BaY}_2\text{F}_8$ which offers broad and intense polarized emission spectra in the mid-infrared (2251–2452 nm); the maximum σ_{SE} is $0.39 \times 10^{-20} \text{ cm}^2$ at 2289 nm (for $\mathbf{E} \parallel \mathbf{Z}$) and the emission bandwidth is exceeding 100 nm (for $\mathbf{E} \parallel \mathbf{X}$). We also revise the transition probabilities for Tm^{3+} ions in LiLuF_4 and BaY_2F_8 crystals using the Judd-Ofelt formalism and accounting for an intermediate configuration interaction (ICI).

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