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# Chemical stabilization of $Eu^{2+}$ in $LuPO_4$ and $YPO_4$ hosts and its peculiar sharp line luminescence.

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The efficient $4f^6 5d \rightarrow 4f^7$ (d-f) luminescence from $Eu^{2+}$ is well-known for host lattices where $Eu^{2+}$ is substituted on a divalent (e.g. $Ca^{2+}$, $Sr^{2+}$) or monovalent (e.g. $Na^{+}$, $K^{+}$) cation site. Only recently some studies appeared concerning d-f emission from $Eu^{2+}$ on a trivalent cation site. The stable $Eu^{2+}$ emission was observed in X-ray irradiated $LuPO_4$:$Eu^{3+}$ crystals where $Eu^{2+}$ is produced through trapping of conduction band electrons generated by X-ray absorption. Here, we demonstrated that $Eu^{2+}$ can also be *chemically* stabilized in $YPO_4$ and $LuPO_4$ through co-doping with a tetravalent charge compensator: $Hf^{4+}$. In orthophosphate crystals doubly doped with Eu and Hf, the characteristic $Eu^{2+}$ emission is observed at low temperatures without the need for X-ray irradiation. The excitation and emission spectra show strong and narrow zero-phonon lines and a rich vibronic structure. In the excitation spectra a multitude of zero-phonon transitions to individual crystal field components of $^7F_J$ multiplets in the $4f^6(^7F_J)5d$ excited state was observed for $Eu^{2+}$ in both $LuPO_4$ and $YPO_4$. Analysis of the spectra is consistent with a slightly larger crystal field splitting for $Eu^{2+}$ on the smaller $Lu^{3+}$ site (compared to $Y^{3+}$). The observation of many $4f^6(^7F_J)5d$ electronic origins make these systems to be model compounds for testing the validity of theoretical models for energy level calculations of $4f^6 5d$ states of $Eu^{2+}$.

Słowa kluczowe

Eu2+ luminescence, Vibronic progression, Lu/YPO4 crystals

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