

Pressure-Induced-Phase Transition and Photoluminescence in Pyrochlore $\text{Ho}_2\text{Sn}_2\text{O}_7$

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An effective way for inducing room temperature photoluminescence (PL) in pyrochlore $\text{Ho}_2\text{Sn}_2\text{O}_7$ was reported by using high-pressure (HP) techniques. The aim is to understand the surprising pressure-induced PL in concentrated materials $\text{Ho}_2\text{Sn}_2\text{O}_7$, which is originated from $\text{Ho}^{3+} \ ^5\text{F}_4/\ ^5\text{S}_2$ to $^5\text{I}_8$ and $^5\text{F}_5$ to $^5\text{I}_8$ transition. The defect-cotunnite HP phase of $\text{Ho}_2\text{Sn}_2\text{O}_7$ with $Pnma$ phase shows a green PL (2.24 eV) and red PL (1.87 eV) at room temperature and above 31 GPa, however, there is no PL either at ambient or low pressure (LP) phase with $Fd-3m$. We associate the loss of Ho^{3+} PL in cubic structure of the concentrated materials $\text{Ho}_2\text{Sn}_2\text{O}_7$ is due to the large volume with lower activation energy than defect-cotunnite HP phase. Therefore, the change of structure symmetry with pressure is in connection with the PL properties in $\text{Ho}_2\text{Sn}_2\text{O}_7$, thus the $Fd-3m$ to $Pnma$ phase transition leads to a quantum yield enhancement, which favors PL recovery. After decomposition pressure, the visible PL is enhanced twice which is due to the irreversible phase transition resulting to an amorphous at ambient pressure.

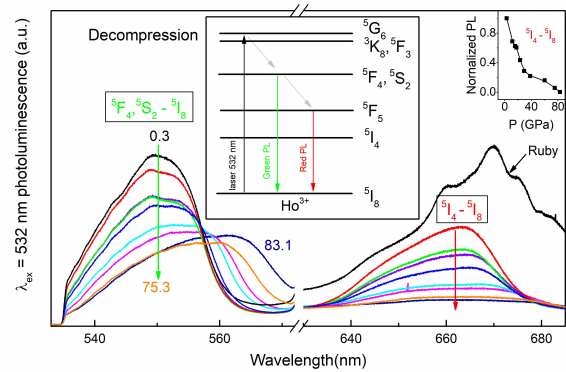


Figure 1. Decompression emissions spectra of $\text{Ho}_2\text{Sn}_2\text{O}_7$ with pressure. Obviously, the PL intensity is enhanced with decreasing pressure and which also exhibits a blue shift with pressure for green PL with the PL energy increased about 0.0338 eV. The inset in the center shows a energy-level diagram of Ho^{3+} with possible emission path way. The left inset shows the variation of the red PL normalized intensity with decompression pressure.

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