Probing metastable Sm$^{2+}$ and optically stimulated tunnelling emission in YPO$_4$: Ce, Sm

When the model dosimetry system YPO$_4$: Ce$^{3+}$, Sm$^{3+}$ is exposed to X-rays, the charge state of the dopants changes, becoming Ce$^{4+}$ and Sm$^{2+}$ via hole and electron trapping, respectively which are metastable; the original charge states can be achieved through electron transfer back from Sm$^{2+}$ to Ce$^{4+}$ via optical stimulation. The work presented here adds further details to the energy levels of the metastable Sm$^{2+}$ defect and the electron transfer processes by undertaking measurements of a) Sm$^{2+}$ excitation spectrum through the internal $^7$D$_{0} \rightarrow ^{7}F_{2}$ emission at 7 K, b) relaxation lifetime of Sm$^{2+}$ ($^7$D$_{0}$ state) and its temperature dependence to provide insights into thermal quenching, and c) the kinetics of localised recombination from Sm$^{2+}$ to Ce$^{4+}$ on nanoseconds to seconds time scales using sub-band-edge excitation.

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