The luminescence of Bi^{3+} in the garnet structure

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The lowest $4f^1 \rightarrow 5d^1$ absorption band of Ce^{3+} in garnet host lattices is at low enough energy to absorb blue light and emit yellow light, making it the main phosphor of choice for white LEDs. However, the reason that this absorption band is in the blue is still an open question, and the relationship between host lattice composition and position of the lowest 4f→5d band in garnets is also not clear. The position of the lowest energy 4f→5d Ce^{3+} transition is dependent upon two factors: the crystal field around the Ce^{3+} ion and the covalency of the Ce^{3+}-O^{2-} bond. It is typically difficult to quantify bond covalency, but one can approach this problem by using Bi^{3+} luminescence, since the position of the $^1S_0 \rightarrow {}^3P_1$ absorption transition is sensitive to the covalency of the Bi^{3+}-O^{2-} bond. We will attempt to use Bi^{3+} luminescence to help decouple covalency effects from crystal field effects at the dodecahedral site of garnets. We will also further investigate the spectroscopy of Bi^{3+} as a function of garnet host lattice composition to additionally study quenching and potential photoionization effects when noble gas ions (Al^{3+}) are replaced by d^{10} ions (Ga^{3+}).