Effect of sample dimensions on observed photoluminescence from Er^{3+} ions in GeGaS and LaGaS glass hosts

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The $^4I_{9/2} - {}^4I_{13/2}$ emission band of trivalent Er^{3+} is potentially interesting light source for methane (CH_4) detection because of its closeness to CH_4 absorption band at 1.67 μm. In the present paper we report the influence of glass sample geometry on the shape of spectra and relative emission intensity of $^4I_{9/2} - {}^4I_{13/2}$ band as well as three main $^4I_{13/2} - {}^4I_{15/2}$, $^4I_{11/2} - {}^4I_{15/2}$ and $^4I_{9/2} - {}^4I_{15/2}$ emission bands in sulfide glasses (GeGaS and LaGaS) doped with 0.5 at.% of Er. We show that the increase of sample size leads to a significant broadening of emission spectra as well as to the substantial suppression of $^4I_{13/2} - {}^4I_{15/2}$ and $^4I_{11/2} - {}^4I_{15/2}$ bands. The observed effects are explained by excitation diffusion or photon trapping (consecutive absorption and emission of light by Er^{3+} ions [1,2]) which turns out to be more effective in large samples. We present the results of Monte-Carlo simulations supporting our considerations and we discuss the possibility of increasing the $^4I_{9/2} - {}^4I_{13/2}$ emission by controlling photon trapping.

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[2] C. Koughia and S. O. Kasap, *Optics Express* **16** (2008) 7709.