Investigation of oxyfluoride glass and glass-ceramics for laser cooling

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Ytterbium-doped heavy metal fluoride glasses have found potential application in laser induced cooling [1-3], they exhibit low maximum phonon energy (500 cm^{-1}) and high photoluminescence quantum yield (PLQY) if compared to traditional oxide glasses (1100 cm^{-1}). However, it is difficult to use fluoride glasses for practical applications due to their relatively low mechanical and chemical resistance. Oxyfluoride glasses containing heavy metal fluorides (~900 cm^{-1}) and PbF_2 nanocrystals (~250 cm^{-1}) may surpass oxide and fluoride glasses by combining their respective advantageous properties, improving thus their mechanical, chemical and luminescence properties. The goal of our study is to identify the best Yb^{3+}-doped oxyfluoride glasses and glass-ceramics (GC), achieve high PLQY, low phonon energy, and low background absorption. The absolute PLQY of the investigated glasses for different concentrations is shown in Figure. The 2 mol% doped Yb^{3+}:glass and GC, determined as optimum for laser cooling applications in addition to serving as a reference for PLQY measurements at 1.0 µm region.

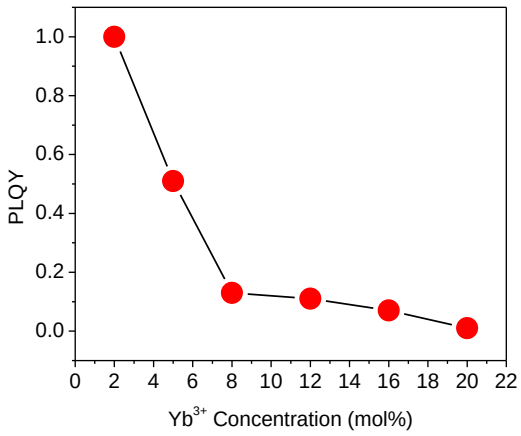

Fig. The concentration dependence absolute PLQY for the Yb^{3+}:glasses.

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[3]. Elton Soares de Lima Filho, Kummara Venkata Krishnaiah, Yannick Ledemi, Ye-Jin Yu, Younes Messaddeq, Galina Nemova, and Raman Kashyap, Optics Express 23, (2015) 4630–4640.