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Understanding the local heating by IR excitation in up converting materials with Xeol Measurements

Elaine A de Mattos,[1] Roger Gomes Fernandes[1,2] Veronica Teixeira[2] and Lucas C. V. Rodrigues[1]

[1]Departamento de Química Fundamental, IQ-USP;
[2]Brazilian Center for Research in Energy and Materials (CNPEM), Brazil

E-mail: elaine.mattos@usp.br

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Nanothermometers present several advantaged when compared to traditional ones; the fast, noninvasive and contactless temperature measurements been only a fraction of these advantages. In the case of luminescence thermometry there is the added prospective applications on extreme temperature settings, and even in harsh environments, and because of their thermally coupled levels, long emission lifetimes, narrow emission bands, lanthanides are ideal candidates for luminescent nanothermometers. However, in up conversion nano thermometers, artifacts may be caused due to local heating by the infra-red laser radiation. On the other side, when exciting with hard x-ray radiation, x-ray excited optical luminesce (XEOL) is generated without strong thermalization. In this work, we explored the well-known thermally coupled energy levels of Er^{3+} ($^2H_{11/2}$ and $^4S_{3/2}$) excited by both a 980 nm and x-ray excitation sources, in the traditional up converting material YF_3:Yb,Er. To understand the heating effects and thermal energy dissipation, we studied the core-shell YF_3:Yb,Er@YF_3 nanoparticle in both powder and film forms. Besides, metallic nanoparticles were added to these systems in order to amplify the thermal conversion. The emission spectrum of the materials remarkably different when exciting with IR laser of X-ray in Carnauba Beam Line (LNLS- Sirius), with significant local heating been observed in the case IR-induced up conversion. These results open the possibility for new applications of this types of thermometers.

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References

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