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Tantalum concentration Influence on the Upconversion of Er^{3+}/Yb^{3+} doped 1-$xGeO_2$-xTa_2O_5 systems and Their Performance as Primary Thermometers

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Recently, we have revealed that Er^{3+}/Yb^{3+}-codoped GeO_2–Ta_2O_5 particles dispersed in poly(methyl methacrylate) (PMMA) exhibit a high absolute emission quantum yield (0.1452, excited at 980 nm). For the first time, it was demonstrated that these particles can simultaneously function as photothermal converters and real-time primary thermometers[1]. Here, the objective of this work is to evaluate the Ge:Ta molar ratio variation and its effect on structural changes, as well as its correlation with near infrared (NIR) to visible up conversion (UC) processes, and performance of the materials as primary thermometers. For that, compounds of Er^{3+} and Yb^{3+} doped germanium (GeO_2) and tantalum (Ta_2O_5) oxides were synthesized (with Ge:Ta of 90:10 to 30:70) by sol-gel methodology, followed by annealing at 1100 °C [1]. Trigonal GeO_2 and orthorhombic Ta_2O_5 crystalline phases were identified, by XRD, increasing the Ta_2O_5 as tantalum concentration. Dynamics of the UC emission were investigated. UC spectra showed emissions attributed to the Er^{3+} ions $^4S_{3/2}$, $^2H_{4/2} \rightarrow {}^4I_{15/2}$ and $^2F_{9/2} \rightarrow {}^4I_{15/2}$ transitions respectively, under excitation at 980 and 1500 nm and laser power ranging from 50 to 500 mW. The intensities of the thermally coupled $^4S_{3/2}$, $^2H_{4/2} \rightarrow {}^4I_{15/2}$ transitions were analyzed changing the temperature from 20 to 100°C demonstrating their potential as primary thermometers based on luminescence.

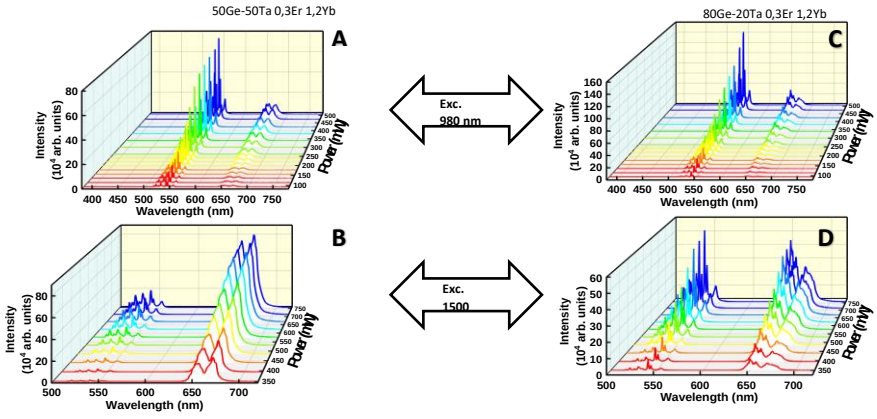

Figure 1. Up conversion spectra of the 50Ge/50Ta sample: (A) with excitation at 980 nm, (B) with excitation at 1500 nm; Up conversion spectra of the 80Ge/20Ta sample: (C) with excitation at 980 nm, and (D) with excitation at 1500 nm.

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References

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