New Ratiometric Sensors Based on Luminescent Rare Earth Vanadate Nanoparticles

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The improvement of different luminescent biolabeling techniques depends on the comprehension of fundamental properties of rare earth (RE)-based nanoparticles concerning their obtainment in colloidal state and their optical behaviour.[1] In this sense, this work comprised new liquid phase synthesis procedures for RE phosphate and vanadate nanoparticles and the investigation of their applicability as new luminescent markers. We evaluated different synthetic approaches involving the colloidal conversion of RE hydroxycarbonates precursors acting as sacrificial templates,[2] as well as formation mechanisms and strategies for controlling particle size, shape and crystallinity. Application of such methodologies enabled the elaboration of systems for ratiometric detection of H_2O_2 based on Eu^{3+} emissions in mixed phosphate-vanadate structures ($REPO_4$-$REVO_4$), which are potentially applicable in intracellular labelling of reactive oxygen species with time and space resolution.[3] In addition, we intended to describe the use of $REVO_4$ nanoparticles as optical temperature sensors[4] via upcoversion luminescence, where highly crystalline colloidal Yb^{3+}/Tm^{3+}-doped vanadates provided ratiometric thermal detections. Such systems can also potentially provide optical thermal sensing at the single particle scale, as isolated structures yield measurable emissions in optic tweezers. In summary, we present correlations between morphological, compositional and spectroscopic properties of RE vanadate nanoparticles aiming at the adaptation of such parameters for the elaboration of new luminescent labelling methodologies.

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The authors thank **CAPES**, **CNPq, CNRS** and **FAPESP**.