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Assembly of plasmonic metal nanorods and luminescent vanadate-based particles for luminescent thermometry

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Systems combining thermometric and heating properties are highly promising to provide spatially resolved information about temperature variations in photothermal assays, also enabling detailed study of spectral variations in RE^{3+} (Y^{3+}, Yb^{3+}, Er^{3+}) emissions caused by surface interactions with plasmonic particles.[1] Whilst local increase in temperature can typically lead to thermal quenching of lanthanide emissions, little is known about how the local surface plasmon resonance effects interact with excited states. In addition, combination of luminescent materials with thermometric properties and metal nanoparticles is promising for elucidating chemical reactions occurring via plasmonic catalysis. For this purpose, plasmonic particles were deposited onto rare-earth vanadate-based[2] (molybdate-vanadate, fluoride-vanadate, and vanadate only) particles by two different strategies, one via an emulsion-based process (Figure 1) and the other through direct anchoring using surface ligands. Subsequently, modulation of the concentration of gold nanoparticles deposited occurred through the applied methodology and the various concentrations utilized, namely 1:1. 1:2 and 1:3 mol/mol. Emission spectra in the Vis-NIR region were obtained to assess the modifications present in the different studied systems, using an excitation wavelength of 980 nm. Additionally, scanning electron microscopy (SEM) was conducted to observe the differences between the two deposition methodologies and to conclude which one provides greater control over the maintenance of plasmonic particle deposition. Indeed, with metallic nanoparticles promoting electronic and thermal effects, it will be possible to understand their consequences on distinct emissions in the visible and NIR regions, elucidating the mechanisms of suppression and enhancement of luminescence (Figure 1).

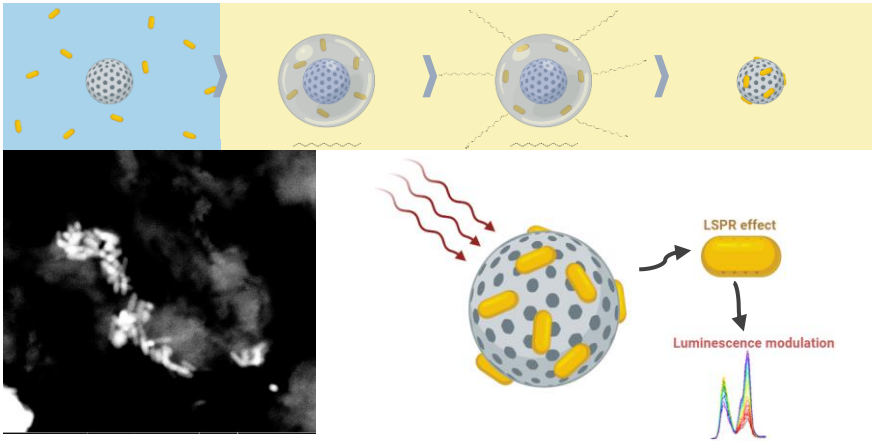

Figure 1. Schematic representation of the deposition methodology based on an emulsion process and SEM image obtained for this system; followed by the representation of modulation of emission spectra through interaction with plasmonic particles with both systems excited at the same wavelength.

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References

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