Synthesis and Characterization of Upconversion Core-Shell Nanoparticles

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Recently, the development of immunocytochemical methods for cell and pathology characterization hasdriven research in pursuit of new and more efficient approaches. In this way, building multifunctional materials which can be used as biological markers, biologically active or carriers of biomolecules is of great interest, mostly in healthy science. Therefore, the present work proposes the synthesis of luminescent core-shell nanoparticles by SiO_2 coating on YVO_4:Yb^{3+}:Tm^{3+} and upconversion phenomenon characterization of Yb^{3+}/Tm^{3+}. Among many other properties, the upconversion process is especially interesting because it allows the absorption of low energy photons, near infrared region, and emission of a high energy photon, visible or ultra-violet range. In addition, the silica coating can be used for drug encapsulation and controlled release. Thus, nanoparticles were prepared by two different methods, in order to compare results. The first was described by D. Giaume et al.,[1] and provides nanoparticles of about 15 nm through rare earth precipitation with sodium citrate and late stabilization with vanadate anion. The second route is adapted from L. Mauline et.al.[2] via microemulsion (Water/Oil) to obtain the YVO_4. The material obtained before the coating was characterized by photoluminescence spectroscopy (figure 1) where it is possible to observe the presence of emission bands due to $^1G_4 \rightarrow {}^3H_6$ transition (474 nm) and $^1G_4 \rightarrow {}^3F_4$ transition (646 nm) upon excitation at 980 nm. After coating (inset of figure 1), the band profile was kept and 3 photons were involved in the process[3]. The material was also characterized by infrared spectroscopy, X ray diffraction and Raman.

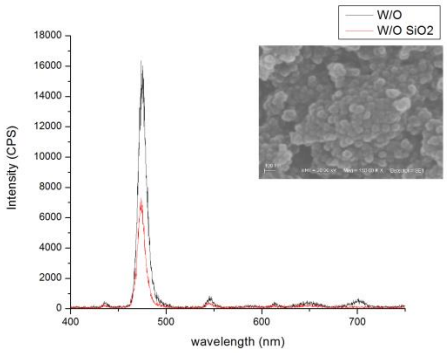

Figure 1.Energy Upconversion emission spectrum of YVO_4:Yb^{3+}:Tm^{3+}nanoparticle obtained by microemulsion route (black) and SiO_2 coated nanoparticle (red), excitation at 980nm. Insert, SEM micrographyof YVO_4:Yb^{3+}:Tm^{3+}@SiO_2.

[1] Giaume, D. et al.*Prog. Solid State Chem.* **2005,***33,* 99-106.

[2] Mauline, L. et al.*Biofouling* **2013,***29*, 1-14.

[3] Suyver, J. F. et. al. *Physical Review B***2005**,*71*, 1251231-1251239.