New near-infrared luminescent nanohybrids obtained by grafting of silylated Ru, Ln and Ru—Ln complexes on mesoporous silica nanoparticles

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The use of d-block chromophores as antenna groups to generate sensitized luminescence from lanthanide(III) ions has attracted substantial attention due to their unique characteristics as (i) photochemical stability and kinetic inertness, (ii) intense absorption arising from allowed low-energy charge-transfer bands, with a maximum that can be selected to be almost anywhere in the UV/Vis/near-IR region and (iii) long-lived excited states, often of the triplet metal-to-ligand charge-transfer (^{3}MLCT), which maximize the likelihood of energy transfer to the Ln(III) ion.[1] Currently, the research involves Ln(III) ions with low energy excited states that emit in the near-IR region, this is of considerable interest in biological applications since it corresponds to the transparency of biological tissues.[2] In this work, we synthesized Ru(II) and Ln(III) (Ln = Nd^{3+}, Yb^{3+}) complexes displaying an alkoxysilane function, in order to functionalize the mesoporous silica nanoparticles thus avoiding leaching of the complexes. By this way, the dilution of the luminescent complexes on silica nanoparticles enhances the luminescent properties due to the protective environment brought about the mesoporous matrix.[3,4] Nanohybrids obtained by the grafting of mono and heterobinuclear Ru—Ln complexes onto mesoporous silica nanoparticles were characterized by solid state NMR, FTIR, FT-RAMAN, Elemental Analysis, TEM, FE-SEM and STEM measurements (figure 1). The results confirm the grafting of each complex by (C-Si-O-Si) covalent bonds. The optical properties of the new nanohybrids will be discussed focusing on the application as a near-IR emitting nanoprobe or nanolabel.

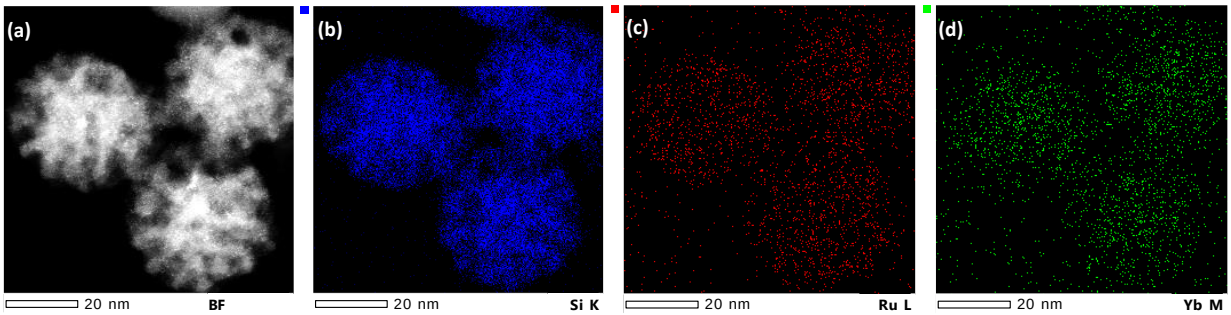

Figure 1. TEM images of the **SiO_2-YbRuL** nanoparticles (a) and STEM elemental cartographies of silicon (b), ruthenium (c) and ytterbium (d) elements.

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