Mesoporous silica nanoparticles containing rare earths for bioapplication: synthesis and characterization

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Mesoporous silica nanoparticles, like MCM-41, are considered excellent materials for drug delivery systems due to their low toxicity, biocompatibility, narrow size distribution, well-defined pore diameter and high surface area [1]. Moreover, the physical characteristics of the rare earths elements, for example, gadolinium (Gd) and samarium (Sm), offer a potential use in magnetic resonance imaging (MRI) and nuclear medicine as radiotherapy, making them a promised theranostic systems to promote diagnosis and treatment of cancer simultaneously [2]. In this study, we employed rare earths compounds (Gd and Sm) incorporated into the silica matrix as a radioisotope carrier, like a theranostic system. The techniques used to characterize these nanomaterials were infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), elemental analysis (CHN), scanning and transmission electron microscopy (SEM/TEM), dynamic light scattering (DLS), X-ray Fluorescence (XRF), X-ray diffraction (XRD), and vibrating sample magnetometry (VSM). To confirm the presence of the gadolinium and samarium in the silica network, optical emission spectroscopy (ICP-OES), XRF, XRD, FTIR, and nitrogen adsorption techniques were employed. The results showed the mesoporous silica nanoparticles were successfully achieved with an average particle size of around 100 nm, also an elevated rate of incorporation of rare earths in the MCM-41 matrix was achieved, indicating that this system presents a potential for application in cancer treatment and diagnosis.

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