HoF_3 and DyF_3 nanoparticles as dual contrast agents for MRI and CT

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Use of contrast agents (CAs) is frequently necessary in MRI (Magnetic Resonance Imaging) to increase the contrast between normal and abnormal tissues. Clinically used MRI CAs are based on gadolinium chelates and superparamagnetic iron oxide nanoparticles (SPIONS). Recently, Gd-based inorganic nanoparticles, such as $NaGdF_4$,[1] appeared as an interesting alternative due to their excellent contrast enhancement, long circulation times and the possibility of target specificity, which leads to reduced dose and minimized damage to normal tissues. However, although Gd-based nanoparticles provide good contrast characteristics at low magnetic fields, they are less effective at high magnetic fields, and this is also the case of Gd-chelates and SPIONS. MRI scanners working at high magnetic fields (>7 T) are more and more demanded nowadays as they increase sensitivity and shorten acquisition times.[2] Therefore, new CAs need to be developed to improve diagnostic capabilities of the new generation of high field MRI scanners. Dy^{3+} and Ho^{3+} are two ions that are suitable for high field T_2 CAs due to their large magnetic moment without saturation of the magnetization at very high magnetic fields.[3] The purpose of this work is to synthesize uniform, water dispersible LnF_3 (Ln= Ho, Dy) nanoparticles, using homogeneous precipitation in polyol medium, and to evaluate their relaxivity at high magnetic field (9.4 T), to be used as MRI CAs in biomedicine. In addition, due to their high atomic number, these DyF_3 and HoF_3 nanoparticles show high X-ray attenuation capacity, which confer a double functionality to the probes, both as MRI and X-ray Computed Tomography CAs.

References

[1] Hou Y. et al. ACS Nano, 7 (2013) 330
[2] Ladd M.E. et al. Prog. Nuc. Magn. Res. Spectr. 109 (2018) 1
[3] Viswanathan S. et al. Chem. Rev. 110 (2010) 2960

Figures

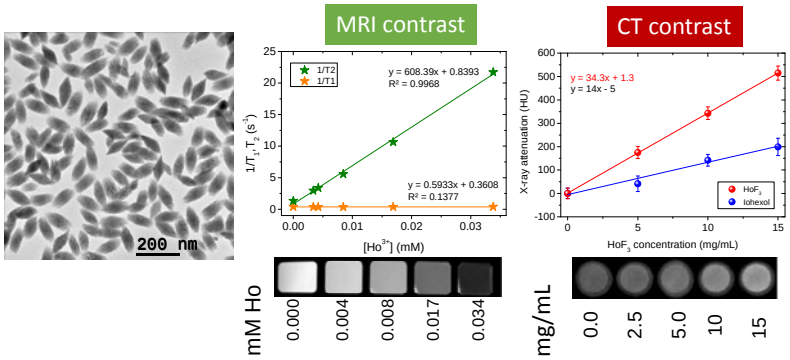

Figure 1: Left: TEM micrograph of HoF_3 nanoparticles synthesized in ethylene glycol at 120ºC. Middle: T1 and T2 proton relaxivity plots and phantoms obtained at room temperature using a 9.4 T magnet in aqueous suspensions of HoF_3 nanoparticles. Right: X-ray attenuation values of HoF_3 nanoparticles in aqueous suspensions and their phantom images.