$HoPO_4$ bioprobes to increase contrast in ultra-high field MRI scanners

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Currently, magnetic resonance imaging (MRI) is one of the most widely used bioimaging techniques for clinical diagnostic. To increase the sensitivity of MRI and, therefore, achieve a more accurate diagnosis, contrast agents (CAs) consisting of Gd^{3+} complexes or superparamagnetic iron oxide nanoparticles (NPs) can be used. Another strategy recently suggested for this purpose, and which is in the experimental stage, is the use of more powerful magnetic fields than those used in the clinic. Unfortunately, the mentioned CAs are not efficient at these high fields so it is necessary to develop new CAs for UHF (ultra-high field) scanners. In this work, we propose the use of holmium phosphate ($HoPO_4$) nanoparticles, due to the high magnetic moment of Ho^{3+} cation [3], and the low water solubility and high biocompatibility of lanthanide phosphates [2]. In order to demonstrate the suitability of such NPs as CAs for UHF MRI, we first describe a method based on a precipitation reaction in polyol medium to synthesize uniform $HoPO_4$ nanocubes (Fig. 1a) with variable size (27, 48 and 80 nm). A procedure for coating them with polyacrylic acid (PAA) to avoid their aggregation in physiological medium, which is a requirement for *in vivo* applications, is also described. Subsequently, the transverse relaxivity (r_2) at ultra-high field (9.4 T) of aqueous suspensions of the obtained NPs is analyzed as a function of the NPs size in order to determine the optimum CA, which turned out to be the one presenting a size of 48 nm. A biocompatibility study of these NPs is also presented, showing the absence of toxicity of these NPs, which is also an essential requirement for their *in vivo* application. Finally, MRI images of different organs of a mouse obtained by UHF MRI in the presence of these $HoPO_4$ NPs are shown (Fig. 1b), demonstrating their potential usefulness as contrast agents for this medical diagnostic technique [1].

References

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Figures

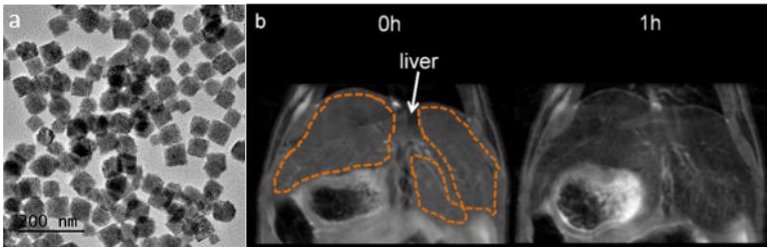

Figure 1: a) TEM micrograph of $HoPO_4$ NPs and b) representative T2-weighted MR images before and after the intravenous injection of such NPs.