solid understanding on the physical and chemical properties of the condensed matter. In summary, this work presents three cases where the use of the Nuclear Techniques improves the characterization of different materials. All the data shown here were collect and published somehow, as indicated below.

This work was published in the Journal of Radioanalytical and Nuclear Chemistry, 306, p. 769–773 (2014). DOI: 10.1007/s10967-015-4310-3

and in the Journal of Alloys and Compounds, 732C, p. 705–715 (Accepted - in press) (2018). DOI: 10.1016/j.jallcom.2017.10.219

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## PRODUCTION AND STUDY OF NANOPARTICLES MAGNETIC PROPERTIES BY HYPERFINE INTERACTIONS

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In the past years nanotechnology was highlighted as a quick growing field, with many applications in science and technology including information storage, drug delivery and medical images, in which gadolinium-based nanoparticles (NPs) have been studied as contrast agent for magnetic resonance image. On the other hand erbium oxide NPs present potential for many applications due to their optical, electrical and photoluminescence properties, and can be used in display monitors, carbon nanotubes for "green" chemistry and in bioimaging, and iron-based NPs have been studied for application in hyperthermia due to its superparamagnetic properties. At the Hyperfine Interactions Laboratory (LIH) NPs are synthesized by thermal decomposition and co-precipitation. Structural characterization is made using X-ray diffraction (XRD) and transmission electron microscopy (TEM) and magnetic properties are studied by magnetization, both at partner laboratories, and perturbed angular correlation (PAC) spectroscopy using $^{111}$In($^{111}$Cd) as probe nuclei at LIH. PAC spectroscopy is based on the angular correlation between nuclear radiations emitted by radioactive probe nuclei, which is a well-established method in nuclear spectroscopy. Perturbation occurs in this correlation by electromagnetic interactions external to the nucleus when it is inserted in a material, which can provide information on the electronic distribution of the neighborhood. In this work, an important material was investigated by PAC spectroscopy using $^{111}$In, which decays to $^{111}$Cd by electron capture, as probe nuclei. Results have shown that NPs produced by thermal decomposition present narrow size distribution, with average size of 5 nm. On the other hand, results related to NPs produced by co-precipitation have shown that NPs don't have a homogeneity in size and shape distribution.

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