Peptide functionalized magnetite nanoparticles: synthesis, characterization and magnetic behavior

O. K. Arriortua, X. Lasheras, I. Gil de Muro, L. Lezama, T. Rojo, M. Insausti

Dept. Química Inorgánica, Facultad de Ciencia y Tecnología, UPV/EHU, Bº Sarriena, 48940 Leioa, Spain
okarriortua001@ikasle.ehu.es

In recent years there has been an important advance in the study of magnetic nanoparticles due to their application in different research fields such as biomedicine. This area has glimpsed their great potential in applications like magnetic hyperthermia, an emerging alternative for the treatment of cancer, where the size of nanoparticles, their stabilization and biocompatibility are key attributes that must be controlled. In this sense, nanoparticles must be in biological environment, requiring a proper optimization of the synthesis method and an adequate surface functionalization, which allows a good stability.

Furthermore, the specificity of the nanoparticles to act only on a certain target is achieved by a proper functionalization. It has been observed in certain cases of cancer overexpress integrins $\alpha_v\beta_3$ in neoplastic cells, process known as angiogenesis. Thus, specific interactions of the cyclic peptide RGD (Arginine-Glycine-Asparagine) with integrin receptor allow selective localization of the magnetic nanoparticles in the tumor area [1]. In this sense, we present the preparation and characterization of magnetite nanoparticles properly functionalized with RGD.

Fe_3O_4 nanoparticles have been synthesized by thermal decomposition of iron (0) pentacarbonyl. Prior to being functionalized with RGD peptide from EDC carbodiimide activation [2] these nanoparticles were transferred to water using an amphiphilic polymer shell (PMAO) [3]. The chemical, morphological and spectroscopic characterization was performed by thermogravimetric analysis, X-ray diffraction, infrared spectroscopy and transmission electron microscopy. Monosdispersed samples with sizes in the 6 to 12 nm range have been obtained with a content of organic matter that vary from one sample to another. The magnetic characterization of the samples has been performed by means of magnetization measurements and magnetic resonance spectroscopy. It has been found a superparamagnetic like behavior for most of the samples with low blocking temperatures. EMR measurements have shown a correlation between the position of g_{eff} value and the size of synthesized nanoparticles, and linewidths that vary with the size dispersion of the nanoparticles.

References

[1] Montet X.; Montet-Abou K.; Reynolds F.; Weissleder R.; Josephson L., Neoplasia, 2006, **8**, 214-222.

[2] M. De la Fuente J., Berry C., Riehle M., Curtis A., Langmuir, **22** (2006) 3286-3293.

[3] Yu W., Chang E., M Sayes C., Drezek R., Colvin V., Journal of Nanotechnology, **17** (2006) 4483-4487.