Synthesis and evaluation of magnetic poly(styrene/divinylbenzene/acrylic acid) microspheres for applications in bio-molecular recognition.

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Abstract

In the present work, the polymerization of styrene-divinylbenzene-acrylic acid monomers by precipitation polymerization[1] with the inclusion of magnetite nanoparticles has been used for the magnetic microspheres formation and use in biomedical application. These magnetic microspheres contain –COOH functional groups, provided by the acrylic acid monomer, suitable for the antibodies coupling and biorecognition of the carcinoembryonic antigen CEA[2-4]. In general, biological interactions with engineered nanoparticles are strongly dependent on variables such as size, morphology, surface charge and reactivity, defects in the nanoparticle surface, elemental composition (core composition) and surface functionalization which directly impact biocompatibility[5].

The research is based on the synthesis and characterization of different magnetic microspheres, studying the influence of the acrylic acid concentration in the final size copolymer and consequently, in the efficiency of the antibody coupling between the primary amino groups (-NH_2) and the carboxyl functional groups (-COOH) of the polymeric surface.

Three magnetic microspheres have been synthesized with different ratios of monomers styrene:divinylbenzene:acrylic acid named M1, M2 and M3, from low to high concentration of acrylic acid and a fixed weight of magnetite nanoparticles (≈10 nm) for all of them. The particle size, analyzed by scanning electronic microscopy (SEM) (Figure 1), and transmission electronic microscopy (TEM), decreases as it increases the acrylic acid concentration (from 0,5 to 0,17 μm approximately) and the saturation magnetization values, measured in an electromagnent, also changed with the size of particle, Figure 2.

The presence of the –COOH groups in the polymeric surface and the –NH and C=O groups after the covalent bounding of the antibodies has been shown by Fourier transform infrared spectroscopy (FTIR).

Molecular techniques, as ELISA assay[6], have allowed quantification of the antibodies coupling and have showed high efficiencies of covalent bound of the added antibody in the case of the magnetic beads that contain the highest concentration of acrylic acid monomer (M2 and M3).

References:

[1]. M. D. Shultz, J. R. Marin, S. H. Naik, J. Wilkins, J. M. Laza, J. L. Vilas, M. Rodriguez, N. Perez, and E. E. Carpenter, Journal of Applied Physics, **105** (1009) 07B318.

[2]. C.N. Ramchand, P. Pande, P. Kopcansky, Ind. J. Pure Appl. Phys., **39** (2001) 683.

[3]. A. Elaissari, M. Rodriguez, F. Meunier, C. Herve, J. Magn. Magn. Mater., **225** (2001) 127.

[4]. S. Hallier-Soulier, E. Guillot, J. Appl. Microbiol., 89 (2000) 5.

[5]. Nanoparticles and Nanodevices in Biological Applications: The INFN Lectures-V.1, (2009), Bellucci S. (Ed).

[6]. Sirley V. Pereira, Germán A. Messina, Julio Rab., Journal of Chromatography B, **878** (2010) 253–25.

Figure 1.

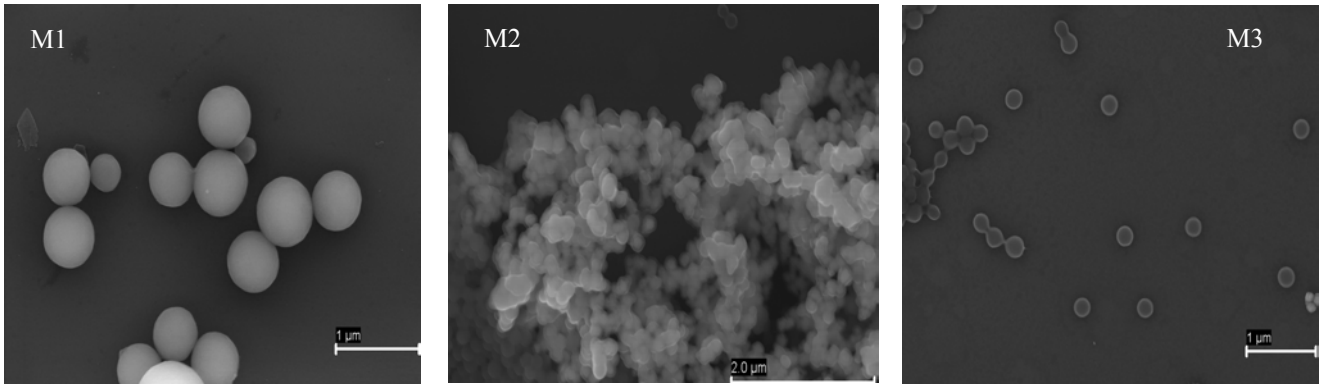

Figure 2.