Magnetic nanoparticles for composite materials with various applications

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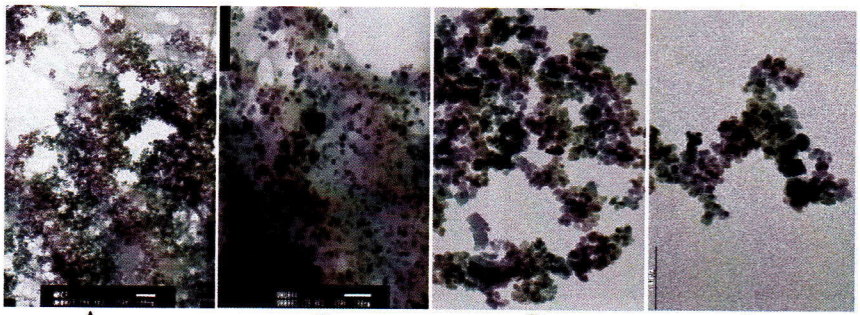
Iron oxide nanoparticles (magnetite, Fe_3O_4) are currently intensely studied due to their versatility and wide application potential. Their high surface area, non-toxic nature and superior magnetic properties render them relevant to many fields of modern nanotechnology, such as biomedicine (MRI contrast agents, hyperthermia treatment, drug delivery formulations, cell separation), separation and purification technology (specialized magnetic adsorbents for waste water treatment or noble metal recovery, emulsion stabilizers in oil industry) and material engineering (composite materials with special properties). In this paper we describe a few particulate systems containing magnetic iron oxide that were synthesized and evaluated for specific applications.

Magnetite nanoparticles obtained ex-situ by co-precipitation and subsequently covered with a crosslinked chitosan matrix deposited by ionic gelation were optimized for possible bio-separation applications after attaching specific ligands to the surface amino groups.[1]

A novel strategy to prepare magnetite-chitosan composite particles involves in-situ mild oxidation of the ferrous ions that were uniformly distributed within the polysaccharide matrix (Figure 1B).[2] The obtained colloidally stable magnetic microspheres bearing surface amino groups proved their superior performance in heavy metal ion complexation (Th^{4+}, UO_2^{2+}, Co^{2+}, Ni^{2+} and Cu^{2+})[3,4].

Magnetite nanoparticles prepared either by co-precipitation (Figure 1C) or by oxidation (Figure 1D) and functionalized using surfactants with various degrees of hydrophobicity are currently studied in our laboratory for controlled colloidal aggregation within polymeric supports to produce patterned surfaces with ice-phobic properties.



A B C D

Figure 1: TEM images of magnetic composite nanoparticles

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