Multifunctional nanocomposite particles for bio-labeling

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The development of nanostructures at a size scale comparable to important biological systems afforded a new set of materials with major impact in medicine. These materials have great interest for several biomedical applications including magnetic cell separation and labeling, drug targeting, hyperthermia treatments and magnetic resonance imaging [1,2]. The incorporation of functional inorganic nanoparticles (NPs) into polymers presents some advantages because the nanocomposites can be tailored to meet requisites necessary for medical applications such as biofunctionalization. Multifunctional particles can be achieved by the judicious selection of the nano-fillers and the interaction of the inorganic NPs with the polymer chains can induce new collective properties.

We have been interested in investigating functional inorganic-polymer nanostructures for bio-applications, including the magnetic separation and labeling of cells. Here we will give examples of synthetic optically active nanocomposites and also magnetic latexes, such as magnetic [3] and gold [4] polymer nanostructures prepared by the miniemulsion polymerization technique. This synthetic strategy involves in a first step the use of organically capped NPs as nano-fillers. The organic molecules at the NPs surfaces not only prevent their coalescence but also allows extensive dispersion of the NPs in organic medium such as the monomers employed in the nanocomposite preparation. In a second stage, the monomers/NPs mixture is dispersed in an aqueous phase containing a surfactant and then sheared using an ultrasonic probe. The polymerization reactions were carried out in conventional free radical conditions using potassium persulfate (KPS) as initiator and under a nitrogen atmosphere. The *in situ* polymerization technique described here involves the formation of colloidal stable monomer droplets in water thus acting as nano-reactors for the polymerization of the monomers in the presence of the selected nano-fillers.[5] As a result of this reaction, an aqueous emulsion containing nanocomposite particles and free polymer is generally obtained whose subsequent separation can be achieved by centrifugation or magnetic separation.

Finally we will discuss results concerning magnetic functionalized latexes of magnetite and maghemite NPs in distinct polymer matrices: poly(butyl acrylate), *tert*- and *n*- (P*t*BA P*n*BA) respectively, polymethylmethacrylate (PMMA) and polystyrene (PS). These composite particles were investigated as magnetic nano-drivers for photoluminescent nanoparticles thus leading to multifunctional nanocomposite particles. Conventional anti-body/anti-gene procedures have been applied as a last step to demonstrate the possibility of producing biofunctionalized nanocomposite particles of interest for *in vitro* bio-applications.

References

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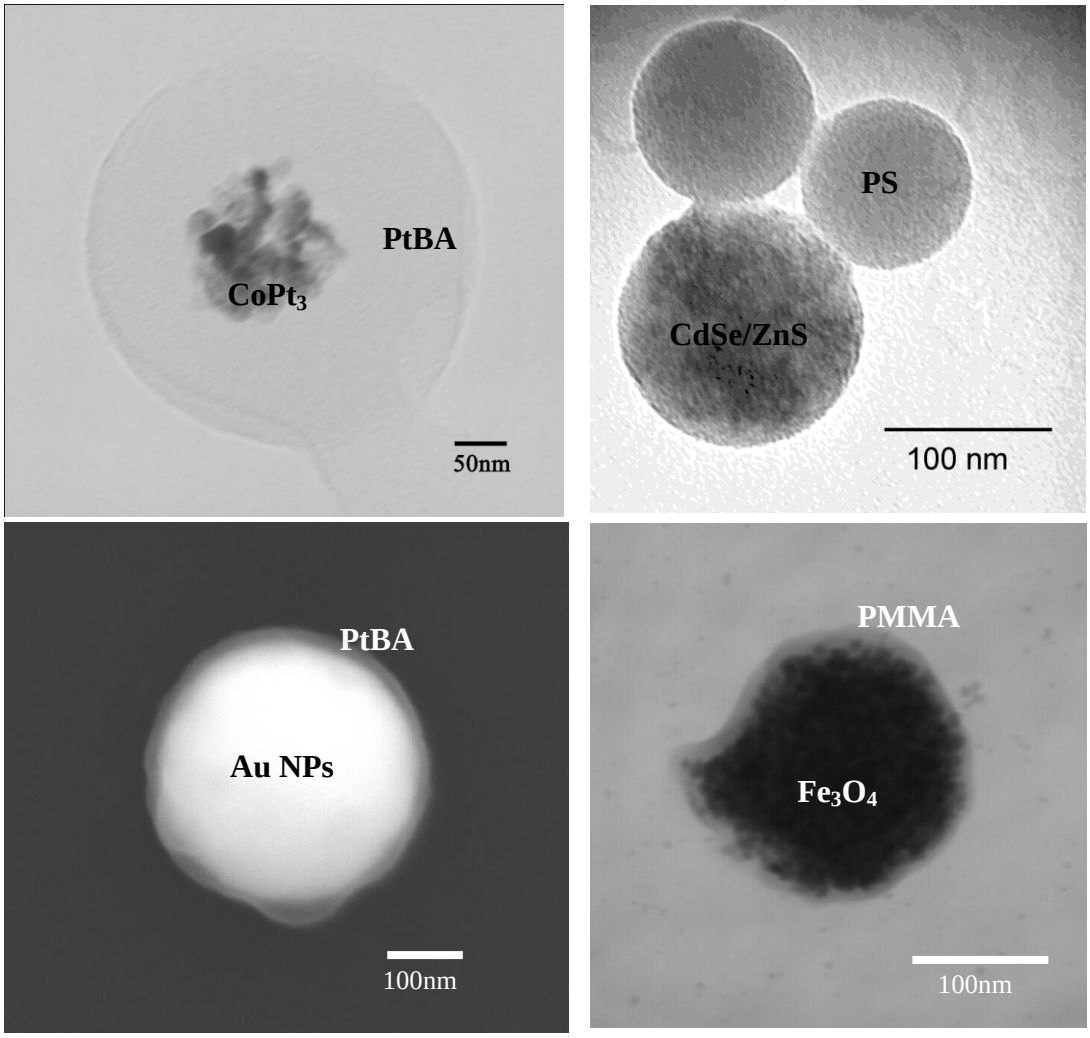

Micrographs of inorganic-polymer nanocomposite particles.

Manuel Martins acknowledges FCT for a PhD Grant (SFRH/BD/29475/2006). Funding provided by FCT and FEDER (project PTDC/QUI/67712/2006).