Controlling nanoparticle aggregation and interfacial properties with polymer mixtures

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This communication reports studies on interfacial properties of different types of nanoparticles controlled by binary mixtures of polymers located at their surface.

The nanoparticles include metallic (gold), metal oxides (magnetic iron oxide, SPIONS) and soft polymer-surfactant complexes in the form of core-shell particles, whose properties are influenced by mixtures of polymers with different chemical nature.

Gold NP´s were prepared with mixtures of polar and apolar polymers such as PEO, PNIPAM and PS attached via thiol end-groups [1]. These modified nanoparticles display interfacial and aggregation properties that are consistent with an anisotropic distribution of the incompatible polymers. In the case of NP´s modified with PNIPAM, a reversible temperature-induced aggregation was observed.

The characterization of these NP´s was carried out by electron microscopy techniques, which confirmed their Janus nature. Further studies on interaction of these Janus NP´s with cell will be reported.

These studies were extended to magnetic iron oxide nanoparticles, in this case using polymers with varied terminal groups such as phosphonic acid, amine and carboxylic acid.

For mixtures of PMMA and PEO, in water/ethanol mixtures, a temperature sensitive behavior was observed, characteristic of an UCST behavior. For some of these magnetic nanoparticles stable emulsions were obtained with properties that varied with the nature of the stabilizing compounds and showed to be responsive to external magnetic field.

Finally, we will present results from a systematic study conducted with core-shell particles formed by block copolymer mixtures with surfactants that display a liquid-crystalline core [2]. Soft NP´s with polymer shells comprised by PEO and PNIPAM chains were prepared and characterized both for pure polymers and their mixtures.

NP´s containing PNIPAM display temperature-induced aggregation and their solution behavior could be tuned by mixing with PEO copolymers. By this approach, a reversible and temperature-controlled NP aggregation was achieved.

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References:

1. A.M. Percebom et al. Chem. Commun. 2016
2. N.M. Carneiro et al. ACS Omega 2017.