

Selective modification of inorganic surfaces with fluorinated molecules using a Pickering emulsion template

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Selective modification of inorganic surfaces with fluorinated molecules was conducted using a Pickering emulsion template. Anisotropic particles were obtained, presenting one hydrophilic and one hydrophobic side. These particles, also called Janus particles, have attracted a lot of interest in recent years, because of their potential use in multiple domains such as cosmetics, pharmacy, and chemical processes, through their special wetting properties and specific particle-particle interactions.

Silica nanoparticles were first studied [1]. These model particles of 250 nm in diameter are spherical and quasi monodisperse. The Pickering emulsion template consists in an oil/water emulsion obtained with wax, which is liquid at 60°C, as an organic phase. The silica nanoparticles stabilized the emulsion as micrometric wax droplets in the aqueous phase. Because of the high hydrophilicity of silica, a surfactant was added to increase its hydrophobicity and the stability of the wax emulsion. At ambient temperature, wax became solid and silica particles were partly entrapped into the organic phase, which made selective functionalization possible.

The Pickering emulsion stabilized by silica nanoparticles was studied using particle size measurement, optical microscopy and scanning electron microscopy (SEM). The optimized silica/wax ratio to obtain a silica particle monolayer at the particle surface was determined by SEM analysis. Then, silica particles were functionalized with aminosilane molecules to attach amino groups at the colloid surface. Finally, a hydrophobic molecule was grafted to silica particles, which were characterized by FTIR, thermogravimetric (TGA) and zeta potential measurements.

The originality of this work results from (i) the selective grafting of fluorinated chains on one side of inorganic nanoparticles, to make this side hydrophobic, and (ii) the versatility of the technique, since this method can be applied to other inorganic particles. In particular, alumina particles are non-spherical and submicronic, and present a positive surface charge. These particles allowed the good stabilization of the emulsion and could be selectively modified by adapting the same protocol. Copper oxalate particles were synthesized by a precipitation method, they present a platelet morphology, and a negative surface charge, and were also processed to be modified by the Pickering emulsion template.

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