Colloidal Approach coupled with Spray-Drying Technique as for Nanostructuring

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Composite nanoparticles with a magnetic core (Fe₃O₄, magnetite) and a photocatalytic shell (TiO₂, anatase) have been investigated for their promising properties as magnetically separable photocatalysts in water depuration systems¹. Such structures can be improved by the deposition of carbon² or silica³ based coatings onto magnetite surface, in order to prevent the photocatalytic activity reduction due to the unfavourable heterojunction between the titanium dioxide and the iron oxide. Several synthetic/colloidal approaches have been described to produce these hierarchical nanostructures where magnetite core is separated by a passive carbon or silica layer from TiO₂ shell. In this work we coupled a new and easily industrially scalable colloidal approach, with spray-drying technique at the aim of engineering TiO₂/magnetite based nanostructures suitable for water depuration systems.

Commercial sols of TiO₂, SiO₂ and Fe₃O₄ were characterized, optimized and a self-assembled layer by layer approach was followed in order to promote the heterocoagulation of silica onto magnetite surface and of titania onto silica coated magnetite, as schematized in Figure 1.

Once optimized, the colloidal mixture was spray-dried in order to obtain a granulated powder (Figure 2) with nano-scale reactivity, easy to handle and re-disperse in comparison to starting nanopowders, with the same surface properties of colloidal system.

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