

# Intensification of environmental photodegradation of pollutants by Pickering emulsions

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Pickering emulsion provides a new way to achieve enhancement of the photocatalysis process efficiency when the solid particles that stabilize the emulsion droplets are made of the photocatalyst itself. Such dual role of the photocatalyst particles is of particular interest for the degradation of non-soluble organic pollutants present as emulsion droplets in the environment. The close proximity of the photocatalyst particles and oil in Pickering emulsions allows a faster photocatalytic degradation of oil.

The present work aims at the validation of this concept. To this end, o/w Pickering emulsions were investigated for their stability and the photocatalytic degradation of the oil inside emulsion droplets was studied.

O/w Pickering emulsions of various models of organic pollutants with low solubility in water were prepared by using titanium dioxide catalysts as stabilizers. So as to allow for adsorption to a wide range of oils, two types of solid particles were investigated: pure TiO<sub>2</sub> having Ti-OH groups at its surface and fluorinated TiO<sub>2</sub> having Ti-F groups at its surface (TiO<sub>2</sub>-F). Those particles were prepared by a sol-gel process and characterized by XRD, BET, SEM, DRS and TG-TD-MS.

The present results indicate that stable Pickering emulsions can be formed using nanometer-sized titanium dioxide particles. The type and stability of emulsions depend on the wettability of the stabilizing TiO<sub>2</sub> nanoparticles assessed by contact angle measurements. Wettability of TiO<sub>2</sub> and TiO<sub>2</sub>-F surfaces strongly depends on the type of oil because of the contributions of the different polarity of the surface groups and of specific interactions with oils. Investigation of Pickering emulsions by electrical conductivity, optical microscopy and light scattering showed that high stability was achieved when conditions of partial wetting with a contact angle in water between 70° and 110° were met. A relationship between oil droplets size and oil-to-TiO<sub>2</sub> mass ratio confirmed the strong adsorption of catalyst particles to oil droplets.

The oils contained in the Pickering emulsions were photocatalytically degraded under UV radiation. The kinetics of photodegradation of organic pollutants measured by HPLC showed the higher degradation rate in emulsion with respect to control experiments in homogeneous solution.

The results proved that use of a Pickering emulsion stabilized by TiO<sub>2</sub> nanoparticles provides an effective and novel way to intensify the photocatalytic degradation of organic pollutants.