

Controlled release of mosquito repellent from TiO₂ functionalized microcapsules

Juliana Marques, Marta Forte, Tiago Gomes, Marlene Calheiros, Clara Gonçalves, Carlos J. Tavares

Centre of Physics, University of Minho, Guimarães, Portugal

The main objective of this research is the functionalization of photocatalytic nanomaterials on the surface of polymeric microcapsules, for the solar-activated controlled release of the encapsulated repellent. The controlled release is promoted by the action of reactive oxygen and hydroxyl species produced during redox processes, as result from the light-activated electronic inter-band transitions in the photo catalyst semiconductor material (Fig. 1).

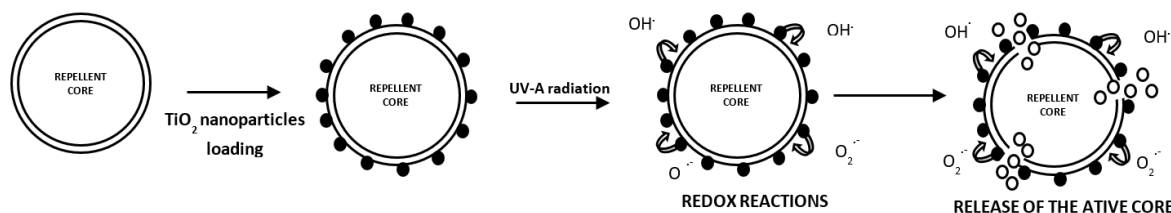


Fig. 1 Mechanism for active agent controlled release from TiO₂ functionalized microcapsules.

The active compound IR3535 was encapsulated in polyurethane microcapsules, prepared using an interfacial polymerization technique. TiO₂ nanoparticles or thin films can be applied for the envisioned application. The TiO₂ nanoparticles, with a specific surface area >250 g/m², were synthesized using a modified sol-gel coupled with hydrothermal treatment. N-doped nanoparticles show lower gap energy, thus enabling visible light absorption (Fig. 2)

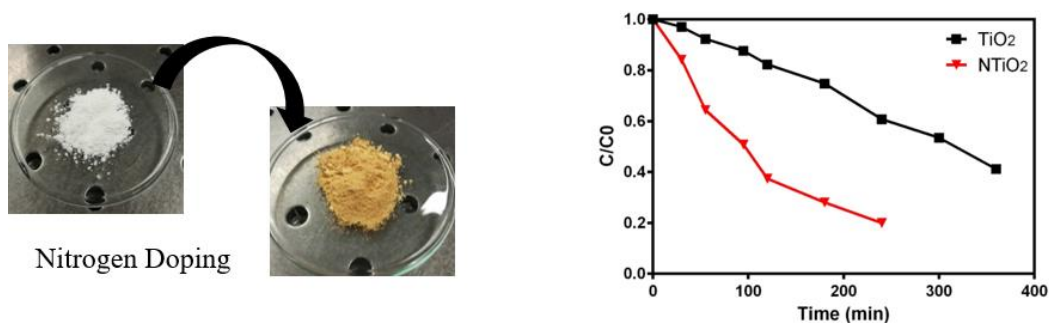
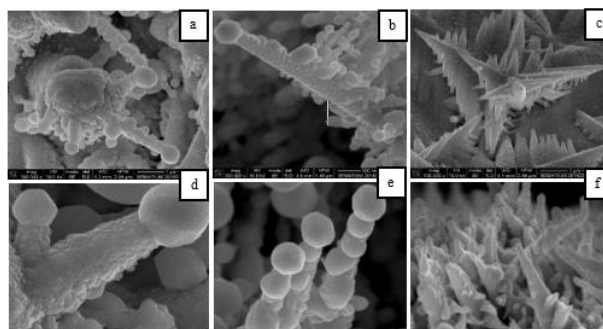


Fig. 2 Photocatalytic effect of the degradation of methylene blue dye by TiO₂ nanoparticles under visible radiation.

Alternatively, photocatalytic surfaces with enhanced specific surface area can be produced by reactive magnetron sputtering in the form of Bi₂O₃:TiO₂ thin films, deposited from a Bi metal target. Different deposition times and O₂ flow rates were evaluated (Figure 3) in the reactive sputtering process. Live mosquitoes' bioassays were carried out at the *Institute of Health and Tropical medicine* in Lisbon to assess the efficacy of these repellent-loaded



microcapsules.

Fig. 3 Bi₂O₃ thin films morphology with different O₂ flow rates a) 14 sccm b) 20 sccm c) 28 sccm. TiO₂ upper layer morphology with different O₂ flow rates d) 14 sccm e) 20 sccm f) 28 sccm.