Synthesis, characterization and application of Fe_3O_4@SiO_2-RB core@shell nanoparticles in Ofloxacin photodegradation

Jenny Flores García*, M. Luisa Marín, Francisco Bosca

Instituto de Tecnología Química, Universitat Politècnica de València-CSIC, Avda. de los Naranjos s/n, Valencia, Spain, E-46022.

* *jenfloga@doctor.upv.es*

The continuous growth of the population and greater industrialization in Spain have resulted in the change of various ecosystems, as a result of high volumes of industrial wastewater discharged directly into water bodies. The use of fluoroquinolone antibiotics (FQs) as therapeutic agents and growth promoters, is increasing all over the world and currently about 100,000-200,000 tons of FQs are used annually.[1] We have synthesized new photocatalysts based on Fe_3O_4@SiO_2 core@shell nanoparticles (NP) covalently derivatized with Rose Bengal (RB) with the final goal of testing them as heterogeneous photocatalysts for the abatement of FQs. The presence of a magnetic core will ultimately facilitate separation. [1,2] The Fe_3O_4@SiO_2 NP were obtained by thermal decomposition at 320 °C, followed by silica coating by reverse microemulsion method.[3] Different amounts of Fe_3O_4 and ammonia / tetraethyl orthosilicate (TEOS) were evaluated to avoid the formation of Fe_3O_4 core free NP and vary the thickness of the SiO_2 shell. The conjugation of RB to the Fe_3O_4@SiO_2 NP was achieved in two steps: firstly, the NP were treated overnight with 3-aminopropyltriethoxysilane (APTES) to obtain Fe_3O_4@SiO_2-NH_2 and subsequently, they were treated with 1-methylimidazole, N-(3-dimethylaminopropyl)-N′-ethylcarbodiimide hydrochloride and RB in DMSO for further 24 h. Finally, they were washed with ethanol and vacuum dried. The obtained photocatalysts (Fe_3O_4@SiO_2 -RB) were characterized by TEM, UV-Vis and ICP. TEM images of SiO_2 NP and Fe_3O_4@SiO_2 NP showed a spherical morphology, with a size of *ca*. 85 nm and a Fe_3O_4 core of *ca*. 12 nm; the presence of RB on the NP was confirmed by UV-Vis and ICP. Photophysical properties of RB anchored to NP were analyzed using the laser flash photolysis technique and its singlet oxygen quantum yield in deuterated water was determined. The efficiency of the synthesized photocatalysts was evaluated for the photodegradation of ofloxacin in model wastewaters. The good results achieved, prone us to export the methodology to other FQs and more complex wastewaters.[1,2]

References

[1] Nasiri, A., Tamaddon, F., Hossein Mosslemin, M., Amiri Gharaghani, M., Asadipour, A., J. Environ. Health 2019, 6 41-51.

[2] L. Riaz, T. Mahmood, A. Khalid, A. Khalid, A. Rashid, M. Bashir, A. Kamal, M. S. Coyne, Chemosphere, 2018, 191, 704-720.

[3] L. Yang, P. Zou, J. Cao, Y. Sun, D. Han, S. Yang, G. Chen, X. Kong, J. Yang, Superlattices Microst, 2014, 76, 205-212.