THE ELECTRODELESS DISCHARGE LAMPS COATED WITH THE TITANIA THIN FILM FOR PHOTOCATALYSIS IN A MICROWAVE FIELD

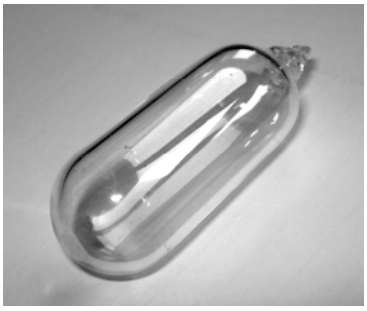
Hana Žabová and Vladimír Církva

Institute of Chemical Process Fundamentals of the AS CR, v.v.i.
Rozvojová 135, 16502 Prague, Czech Republic

The electrodeless discharge lamp (EDL) generates UV/VIS radiation when placed into the microwave field and is connected to the objective of microwave photochemistry [1]. The EDL consists of a glass tube filled with an excitable substance (Hg) and sealed under a lower pressure (20 Torr) of argon.

Titanium dioxide is considered the most hopeful and popular photocatalyst and in form of thin film shows a lot of attractive properties. Irradiation of titania by light of energy greater than the band gap results in the formation of an excited electron (e^-) and positive hole (h^+) pair. These e^- and h^+ reduce and oxidize chemical species on the surface of photocatalyst. Titanium dioxide was prepared by sol-gel method. A titanium (IV) butoxide was dissolved in acetylacetone and used as a molecular precursor of TiO_2. Titania thin films were prepared by dip coating of the pretreated support (EDL) into the titania sol. The integration of dopants into the sol during gelation process offers the ions to have direct interaction with TiO_2. Therefore, dopants could be incorporated into the lattice of titania. Doping with transition metal ions M^{n+} (M=V, Cr, Mn, Fe, Co, Ni, Cu, Ag) allows prolonging the light absorption to the visible region.

The photocatalytic activity was evaluated by degradation of mono-chloroacetic acid (MCAA) in a microwave field using batch reactor [2]. Experimental set-up is consisted of round-bottom flask equipped with Dimroth condenser. In each experiment, the reactor was filled with an aqueous solution of MCAA. Then the coated EDL was placed into the reaction mixture and microwave field induced UV radiation. Samples were analyzed by chloride ion-selective electrode. Several factors influencing the degradation of MCAA, such as initial pH value, H_2O_2 dosage and the presence of dopants have been studied in detail. The decomposition was enhanced in an alkaline solution and in the presence of H_2O_2. The UV-Vis spectra of some M^{n+} doped titanium dioxide show significant absorption in visible region and the degradation efficiency was higher than those of pure TiO_2.



[1] P. Klán, V. Církva, Microwaves in Photochemistry, in: A. Loupy (Ed.), Microwaves in Organic Synthesis, Wiley/VCH, Weinheim, 2006, p. 860-897.
[2] V. Církva, H. Žabová, M. Hájek, J. Photochem. Photobiol. A: Chem. (2008) in print.