N, Fe single-doped and N-Fe co-doped TiO_2 powders and films increasing photoactivity under visible light

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Abstract:

Nowadays, environmental pollution is a major concern in our society and numerous researches are realized to treat water, air and soil pollution. Among the different methods developed to reduce pollution, photocatalysis is a way to degrade organic pollutants. Aqueous sol-gel methods can be used to produce TiO_2 photocatalytic powders or coatings. The aim of the present work is to develop new (co)-doped TiO_2 samples to extend their photocatalytic efficiency towards visible region with optimal production costs. The loading of dopants (N, Fe) are optimized to improve the photocatalytic activity for dyes degradation. Moreover, the shaping of photocatalysts in the form of homogeneous thin films is also studied on different supports. The durability and the leaching of the best coatings is finally evaluated to define their lifetime for future applications concerning the depollution and disinfection of natural recreative water areas.
Doped TiO_2-based catalysts have been synthesized by aqueous sol-gel route. They differ by the nature of doping: iron doping (0.25 and 0.5 %mol), nitrogen doping (from 10 to 75 %mol) and iron-nitrogen co-doping. A set of characterizations was carried out on the photocatalysts. X-ray diffraction allowed to prove the presence of anatase in the synthesized samples and this without calcination at high temperature, which is an undeniable advantage of this method of synthesis. The UV/Visible diffuse reflectance has shown that doping shifts the TiO_2 activity towards the visible. Catalyst activity was measured by monitoring the degradation of *p*-nitrophenol (PNP) after 24 h under visible light at 18 °C. In this case, samples TiO2N43Fe0.25 et TiO2N43Fe0.5 are the most efficiency. Colloids prepared from these powders were spray-coated onto stainless steel substrates. After a large number of optimizations, we obtained 100% degradation of PNP in 8 h at 18 °C with the TiO2N43Fe0.25 coating having an average thickness between 2 and 4 µm.

Biography of presenting author (should not exceed 100 words)

Prof. Dr. Ir. Stéphanie D. Lambert (SL) is a professor and a FRS-FNRS senior research associate in the Department of Chemical Engineering (DCE) of the University of Liege since 2009. She obtained her Ph.D. in Applied Sciences in 2003. After an engineer position in the chemical company Nanocyl (2004-2005), and two postdoctoral stays at the DCE of the University of Illinois at Chicago in 2006, and at the Institute Charles Gerhardt in Montpellier in 2007-2008, she joined the DCE of ULiège, in which she develops inorganic (bio)materials for environmental (bio)chemistry. SL has published over 104 publications and 12 book chapters.

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