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Plasmon metal enhanced titanium dioxide photo-catalyst nanoparticles for the removal of organics in water

Pardon Nyamukamba[1], **Sampson Mamphweli**[1], **Lillian Tichagwa**[2] and **Leslie Petrik**[3]
[1]University of Fort Hare, South Africa
[2]Harare Institute of Technology, Zimbabwe
[3]University of the Western Cape, South Africa

In photo-catalysis, titanium dioxide (TiO_2) is considered as one of the most important photo-catalysts to solve environmental problems particularly in water purification due to its high refractive index, photo-stability, low cost and photochemical reactivity. Nanotechnology based methods have proved that nano-sized metal oxide catalysts can have high activity in the photo-degradation of a wide range of organic and inorganic contaminants in water. Unfortunately, the photo-catalytic activity of TiO_2 photo-catalyst is compromised by the high electron hole recombination and the wide band gap of 3.2 eV meaning it can only absorb light of $\lambda<387$ nm. It is therefore important to increase the spectral response of TiO_2 from ultraviolet to the visible region and also to reduce the electron hole recombination rates. The use of plasmon elements such as silver and gold is believed to make TiO_2 photo-catalyst capable of effectively removing contaminants such as halogenated aromatic compounds, dyes and other endocrine disruptor compounds which have become serious environment contaminants because of their long life and chemical stability. In this study, TiO_2 was co-doped with carbon and silver to reduce band gap and then mixed with silver nanoparticles to act as electron reservoirs. The prepared samples were characterized by UV-Vis diffuse reflectance spectroscopy, high resolution scanning electron microscopy (HRSEM) and X-ray diffraction (XRD). The photo-catalytic activity of the TiO_2 photo-catalyst as a thin film on quartz was evaluated using bromo-cresol purple and methyl orange as model pollutants. The prepared photo-catalysts were found to be more effective when compared to pure TiO_2 and bromocresol purple was easier to degrade than methyl orange.

daddypardy@gmail.com

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