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SIMPLE METHOD TO SYNTHESIZE OF Fe_2TiO_5-TiO_2 HETEROSTRUCTURES FROM ILMENITE AND THEIR PHOTOCATALYTIC ACTIVITY FOR DEGRADATION OF METHYLENE BLUE

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The quest to find practical solutions in producing a clean environment is a global challenge due to the environmental pollution caused by the anthropogenic activities. TiO_2 is the mostly experimented semiconductor that degrades pollutants via advanced oxidation process due to its ability to achieve complete mineralization. The main objective of this study is to synthesize photocatalytically active pesudobrookite-titania heterostructure nanoparticles from natural ilmenite that is extensively available in the coastal areas of Pulmodai and Induwara, Sri Lanka. In order to achieve this, purified ilmenite was acid digested in conc. HCl, and conc. NH_3 was added dropwise to that solution. Brown coloured precipitate was annealed at 800 °C for 2 hours. The product was characterized by X-ray diffractormetry (XRD), transmission electron microscopy (TEM), UV-Visible spectroscopy, Raman spectroscopy, scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS) and energy-dispersive X-ray spectroscopy (EDS). According to the XRD and Raman spectroscopic data, the nanoparticles synthesized consist of a heterostructure of Fe_2TiO_5 and TiO_2 where both rutile and anatase phases of TiO_2 are present. TEM and SEM images show agglomerated nanoparticles of about 50 nm and EDS spectra prove the presence of Ti and Fe. Higher resolution XPS spectra show that the surface of the nanoparticles consists of Fe^{3+} and Ti^{4+}. The band gap was calculated as 2.05 eV by diffuse reflectance UV-Visible spectroscopy and a type I heterostructure has been produced. Photocatalytic activity of the synthesized heterostructure nanoparticles was evaluated by photodegradation of methylene blue by direct sunlight. Fe_2TiO_5-TiO_2 heterostructures show 76% conversion of 3 mg L^{-1} methylene blue after 2 hours, and addition of H_2O_2 improved the catalytic activity resulting 96% conversion of methylene blue. This result clearly indicates that electron-hole pair recombination has taken place in the synthesized new heterostructure and that has been prevented by addition of an electron acceptor such as H_2O_2.

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