Abstract No: MO-08

Photocatalytic activity of Cobalt-doped Fe_2TiO_5 nanoparticles from natural Ilmenite using acid leaching steps under visible light

C. Thambiliyagodage[1] and M. R. Liyanage[2*]

[1] School of Science and Education, Faculty of Humanities and Sciences, Sri Lanka Institute of Information Technology, Sri Lanka
[2] College of Chemical Sciences, Institute of Chemistry Ceylon, Sri Lanka
manthilr@gmail.com*

This research project was primarily carried out to observe the photocatalytic decolourisations of Cobalt-doped Fe_2TiO_5 nanoparticles in wastewater contaminated with dyes. The possibility of using commonly accessible Ilmenite as a raw material in a low-cost, non-toxic, stable, and highly reactive process of synthesising the aforementioned Fe_2TiO_5 is also explored in this research. Acid-leaching techniques were used, to remove impurities. Then Ammonia solution was used for precipitation, followed by filtration, drying, and calcination at 700^0C to produce Fe_2TiO_5 nanoparticles. Cobalt salt was added to the acid leachate, and the same precipitating and calcination procedure was followed to produce $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$, which were then characterised utilising PXRD, Raman spectroscopy, XRF, XPS and SEM. PXRD patterns collected to identify the crystal structure of the synthesised nanoparticles show the presence of pseudobrookite, Fe_2TiO_5 and α-Fe_2O_3. Moreover, finding peaks in PXRD analysis for $CoO/Co_2O_3/Co_3O_4$ is challenging due to the low concentration of Co utilised. Raman analysis part depicts the existence of α-Fe_2O_3 and the anatase phase of TiO_2 in the Cobalt-doped sample. XRF analysis was performed on a Cobalt-doped sample to identify the elemental distribution of Ti, Fe, Co and other elements. XPS analysis reveals the presence of Ti, Fe, O, C, and Co in the Cobalt-doped sample, confirming the $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$ composition. The aforementioned analysis techniques confirm the Fe_2TiO_5/TiO_2 in the initially synthesised undoped sample. SEM image of synthesised Fe_2TiO_5 shows the distribution of an irregular nanostructure of small and large nanoparticles. However, the Cobalt-doped sample shows how the irregularity is disturbed. The catalytic activity of Fe_2TiO_5/TiO_2 and Cobalt-doped catalysts was observed in the presence and absence of persulfate under sunlight using UV visible spectroscopy. The $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$ nanoparticles showed 37.31% dye removal for Methylene Blue after 2 hours, which was an insignificant result under sunlight. However, the addition of persulfate also did not show any significant improvement in the dye removal percentage, with only 32.54% decolouration of Methylene Blue observed after 2 hours. These results show a negligible photocatalytic effect in Cobalt-doped Fe_2TiO_5 nanoparticles using low concentrations of Cobalt.

Keywords: Acid, Base, Cobalt-doped, Ilmenite, Photodegradation

Acknowledgement
This work was supported by the College of Chemical Sciences, Institute of Chemistry Ceylon, Sri Lanka.