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Synthesis and Characterization of Al-Doped ZnO Nanoparticles by Electrochemical Method: Photodegradation Kinetics of Methylene Blue Dye and Study of Antibacterial Activities of Al-Doped ZnO Nanoparticles

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ABSTRACT

Al doped ZnO Nanoparticles have been successfully synthesized by electrochemical method which is simple and inexpensive method. The synthesized Nanoparticles were used as a catalyst for the study of photodegradation of methylene blue dye. The electrochemically synthesized Al/ZnO Nanoparticles were characterized by UV-Visible spectroscopy. SEM-EDAX, FT-IR spectrum and X-ray diffraction studies. The study of UV-Visible spectroscopy indicates that the Al/ZnO Nanoparticles shows maximum intensity peak at 230.79 nm in the UV region and there is no absorption peak in the visible region therefore the synthesized Nanoparticles is active under UV light. The band gap energy of synthesized Nanoparticles is 4.64eV it was calculated using Tauc plot. The SEM results show that the synthesized Nanoparticles appear as nanoflakes with agglomerated particles. The EDAX spectra showed that the presence of Al, O and Zn in the synthesized Nanoparticle. The FT-IR spectra revels that the functional groups present in the molecular structure .The XRD data revealed that the crystal structure of the synthesized Nanoparticles is hexagonal and average crystalline size was found to be 25.51 nm for the Al/ZnO Nanoparticle. The photocatalytic activity of the synthesized Al/ZnO Nanoparticles was examined by the kinetics of photodegradation of methylene blue dye .The degradation efficiency was found to be 96%.The antibacterial activity for ZnO and Al/ZnO Nanoparticles was investigated by using Bacillus subtilis MTCC 2763 and Escherichia coli MTCC 40 of different bacteria.

Graphical Abstract

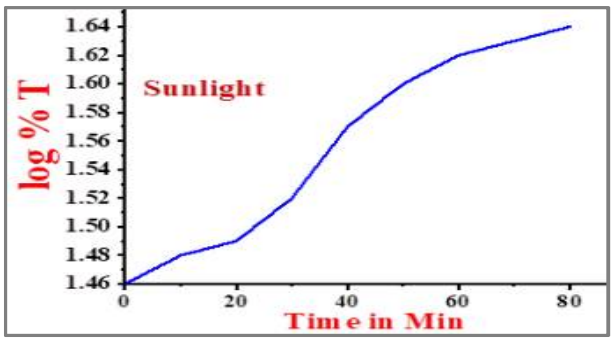

Figure 11. Effect of concentration of Methylene blue dye on the rate of degradation under sunlight.

Keywords: Electrochemical method, Al/ZnO Nanoparticles, Methylene Blue dye, Antibacterial activity.