World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:13, No:02, 2019

Synthesis, Characterization and Photocatalytic Applications of Ag-Doped-SnO_2 Nanoparticles by Sol-Gel Method

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Abstract : In recent years, photocatalytic degradation of various kinds of organic and inorganic pollutants using semiconductor powders as photocatalysts has been extensively studied. Owing to its relatively high photocatalytic activity, biological and chemical stability, low cost, nonpoisonous and long stable life, Tin oxide materials have been widely used as catalysts in chemical reactions, including synthesis of vinyl ketone, oxidation of methanol and so on. Tin oxide (SnO_2), with a rutile-type crystalline structure, is an n-type wide band gap (3.6 eV) semiconductor that presents a proper combination of chemical, electronic and optical properties that make it advantageous in several applications. In the present work, SnO_2 nanoparticles were synthesized at room temperature by the sol-gel process and thermohydrolysis of $SnCl_2$ in isopropanol by controlling the crystallite size through calculations. The synthesized nanoparticles were identified by using XRD analysis, TEM, FT-IR, and Uv-Visible spectroscopic techniques. The crystalline structure and grain size of the synthesized samples were analyzed by X-Ray diffraction analysis (XRD) and the XRD patterns confirmed the presence of tetragonal phase SnO_2. In this study, Methylene blue degradation was tested by using SnO_2 nanoparticles (at different calculations temperatures) as a photocatalyst under sunlight as a source of irradiation. The results showed that the highest percentage of degradation of Methylene blue dye was obtained by using SnO_2 photocatalyst at calculations temperature 800 °C. The operational parameters were investigated to be optimized to the best conditions which result in complete removal of organic pollutants from aqueous solution. It was found that the degradation of dyes depends on several parameters such as irradiation time, initial dye concentration, the dose of the catalyst and the presence of metals such as silver as a dopant and its concentration. Percent degradation was increased with irradiation time. The degradation efficiency decreased as the initial concentration of the dye increased. The degradation efficiency increased as the dose of the catalyst increased to a certain level and by further increasing the SnO_2 photocatalyst dose, the degradation efficiency is decreased. The best degradation efficiency on which obtained from pure SnO_2 compared with SnO_2 which doped by different percentage of Ag.

Keywords : SnO_2 nanoparticles, a sol-gel method, photocatalytic applications, methylene blue, degradation efficiency
Conference Title : ICENN 2019 : International Conference on Essentials in Nanoscience and Nanotechnology
Conference Location : Sydney, Australia
Conference Dates : February 27-28, 2019