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DEGRADATION OF ERIOCHROME BLACK-T USING SnO_2 NANOPARTICLES

A. FATHIMA BEEVI[a], G. SREEKALA[b] AND B. BEENA[c1]

[abc]Nanoscience Research Lab, Department of Chemistry, K.S.M.D.B. College, Sasthamcotta, Kollam, India

ABSTRACT

SnO_2 nanoparticles were synthesized by sonochemical method using Tin Tetrachloride and Ammonium Hydroxide as precursors. The prepared SnO_2 nanoparticles were characterized by PXRD, FTIR, UV-Vis and SEM- EDX. The dye degradation activity of the prepared sample was investigated by degradation of Eriochrome Black-T in aqueous medium under natural sunlight using UV-Vis spectrophotometer. The prepared SnO_2 nanoparticles are efficient for removing water soluble dyes.

KEYWORDS: SnO_2 Nanoparticles; Sonochemical Method; Degradation; Eriochrome Black-T

In recent decades, the semiconductor photocatalysts with high performances for water contaminant degradation have attracted great interest to solve environ mental issues. Among the various nanocrystalline materials, tin oxide is a versatile oxide having wider applications. Because of its strong physical and chemical interaction with adsorbed species, low operating temperature and strong thermal stability SnO_2 is widely used as a common 'n' type direct wide band gap semiconductor and photocatalyst. There are a variety of techniques that have been developed to prepare nano particles. They are sol-gel, solvothermal, microwave, chemical co-precipitation, hydrothermal and sonochemical methods. In the present work, the sonochemical method was employed to prepare tin oxide nanoparticles.

Eriochrome black-T is an azo dye used in textile industry. The complex chemical structure of Eriochrome black-T offers a greater resistance to photodegradation as well as certain chemical reagents, impairing the removal or reduction of its colour during the waste water treatment (Barka et al;2011).

MATERIALS AND METHODS

Synthesis of SnO_2 nanoparticles

Typically, 50 mL of 0.4M Ammonium hydroxide solution was first added drop wise to 50 mL of 0.1M tin tetrachloride [($SnCl_4.5H_2O$), 97%, Sigma- Aldrich] solution and kept under continuous stirring for 30 minutes. Then the solution was sonicated for 1 hour (230 volts, 50Hzs). Thus obtained precipitate was washed, dried and calcined at 300^0C for 3hours.

Characterisation of SnO_2 Nanoparticles

The crystalline quality and grain size of the samples were evaluated using Powder X-ray diffraction (PXRD) measurements. The morphology of sample was examined using Scanning Electron Microscopy (SEM). Chemical nature of the synthesized $SnO_2$was analysed by FT-IR spectrum. The band gap and optical properties of the nanoparticles were studied using UV-Visible spectrum.

Preparation of Eriochrome Black-T Solution

The accurately weighed 0.01gm quantity of the Eriochrome black-T dye was dissolved in 100mL of distilled water.

Dye Degradation using Nano SnO_2

The photodegradation activity of nano SnO_2 is carried out by mixing 0.015gm of the sample and dye solution at 10minute intervals and recording the UV-.Visible absorption spectra.

RESULTS AND DISCUSSION

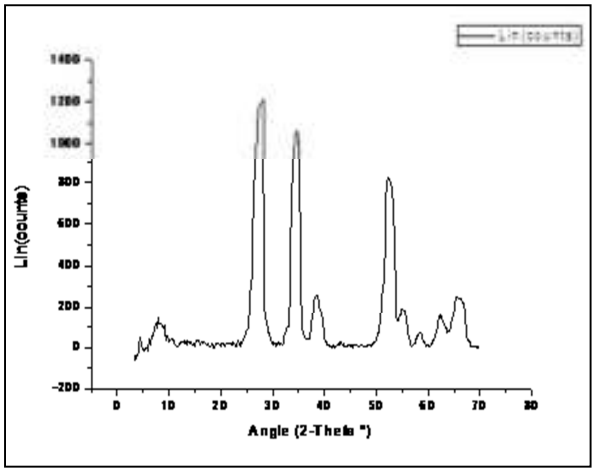

Figure 1: PXRD spectrum of SnO_2nanoparticles

[1]Corresponding Author

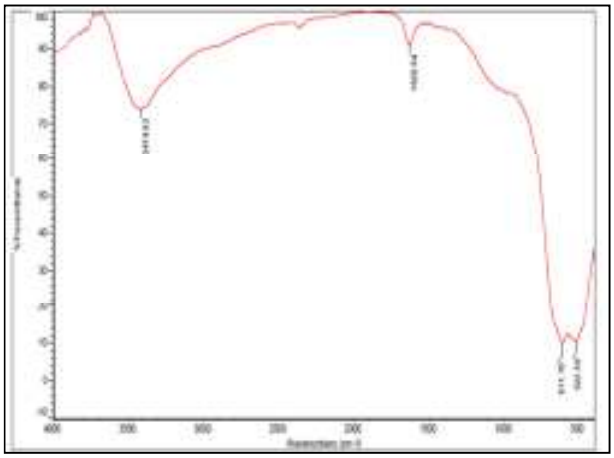

Figure 2: FT-IR spectrum of SnO_2 nanoparticles

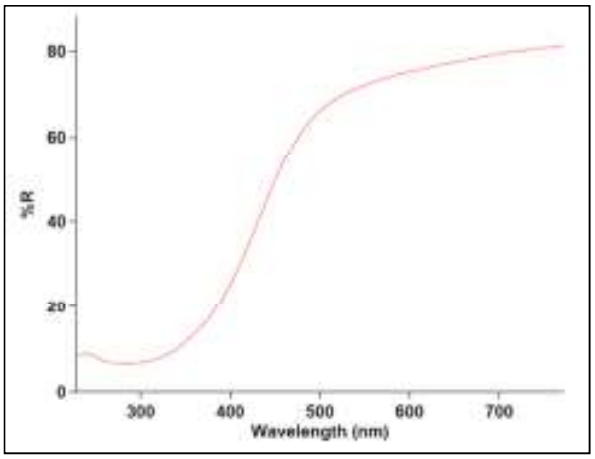

Figure 3: Reflectance spectrum of SnO_2 nanoparticles

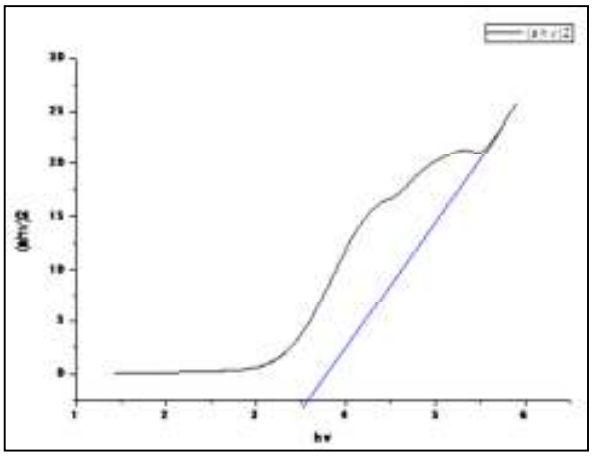

Figure 4: Tauc's plot of SnO_2 nanoparticles

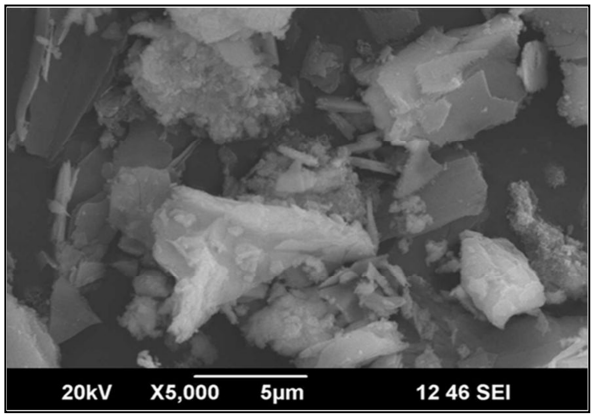

Figure 5: SEM image of SnO2 nanoparticles

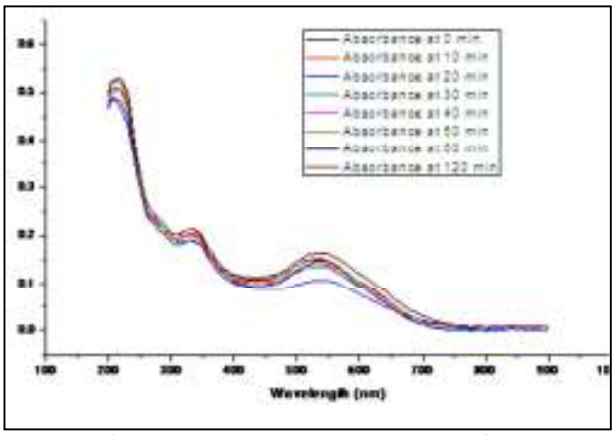

Figure 6: UV-Visible Absorption spectra of EBT at various time intervals

The X-ray diffraction is used to identify crystalline structure and particle size of the samples. X-ray diffraction patterns of our sample of $SnO_2$are shown in Figure.1. The diffraction peaks readily indexed to the tetragonal rutile phase of SnO_2 (JCPDS No.77-0450). From the crystallite size calculation, using Scherrer equation, $t=0.9\lambda/\beta\cos\theta$, the average size of prepared sample of SnO_2 is between 10-20 nm.

The FTIR transmission spectrum of the synthesised SnO2 is shown in Figure.2. The peaks at 3414.53cm^{-1} and 1629.54cm^{-1} were due to stretching and bending vibrations of water molecules or hydroxyl groups adsorbed at the surface of the tin oxide.(S.Y.Ho,et al 2009.) The bands at 611.18 cm^{-1} and 522.58cm^{-1}refers to Sn-O stretching modes of Sn-O-Sn.(Farukh et al. 2010)

SEM image shows the flakes like morphology of the prepared sample in Figure 5.

From UV-Vis Spectra and Tauc's relation, $\alpha h\nu = A (h\nu - E_g)^n$, the band gap obtained is 3.6eV [Figure.3, Figure.4 and Figure.6] .The SnO_2 prepared by sonication

method is a good adsorbent for the removal of Eriochrome Black-T and points out the potential application of the material for waste water treatment .

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