Preparation and characterization of Bi-based mixed metal oxides

Thesis submitted in partial fulfilment

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Doctor of Philosophy

by

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7.1. Summary

- Bi-based mixed metal oxides,$BiFeO_3$, $Bi_2Fe_4O_9$ Bi12TiO20 and$Bi_{25}FeO_{40}$ceramics were synthesized by chemical-wet route and single-phase formation was confirmed by XRD studies.
    - The made-up photocatalysts of $BiFeO_3$ ceramic were characterized using different characterization techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), diffuse reflectance spectroscopy (DRS), cyclic voltammetry (CV) and X-ray photoelectron spectroscopy (XPS). Furthermore, the photocatalytic activities of synthesized $BiFeO_3$ were evaluated by photodegradation of methylene blue dye. In addition, the UV-visible study of BFO revealed a direct transition at 2.2 eV for the visible light absorption.
    - $Bi_2Fe_4O_9$studied as active photocatalysts. The sample was characterized by using different characterization method such as X-ray diffraction (XRD), Scanning electron microscopy (SEM), transmission electron microscopy (TEM). Additionally, the photocatalytic activities of three electrode system is found to be 215 F/g, and it exhibits pseudocapacitive nature. The electrode has a comparatively less charge transfer resistance of 11.5 **Ω**. The dielectric constant of the $Bi_2Fe_4O_9$ was calculated with variation temperature and frequency and found to be645.45 at 20 Hz and 373K.Synthesized $Bi_2Fe_4O_9$ was evaluated by photodegradation of Congo Red (CR). The Effect of process time, adsorbent dose and initial Congo Red concentration were optimized at batch mode and the outcomes demonstrate that $Bi_2Fe_4O_9$ shows the pre-eminent potential for the photodegradation of Congo Red. The UV-visible study of BFO revealed a direct transition at 1.8 eV for the visible light absorption. The frequency and temperature-dependent AC conductivity observed by Arrhenius equation explains the hopping charge mechanism in the $Bi_2Fe_4O_9$ ceramic.

- Bi_{12} TiO_{20} ceramic was fabricated at low temperature (600°C) with short duration of calcinated temperature. Single-phase of$Bi_{12}TiO_{20}$nanocrystalline ceramic has particle in the range of 40-60nm. XRD and EDX studies confirmed the purity and stoichiometry of the Bi12TiO20 ceramic. The $Bi_{12}TiO_{20}$ ceramic exhibited a high dielectric constant (6.1×10^3) with low dielectric loss (2.45) at 100 Hz. These results show that the dielectric properties of $Bi_{12}TiO_{20}$ ceramic are dependent upon the methodology of synthesis routs.
- $Bi_{25}FeO_{40}$ ceramic was studied as efficient photo catalysts. The synthesized photocatalysts were characterized using different characterization techniques, such as X-ray diffraction (XRD), Fourier transform infrared (FT-IR), Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and X-ray photoelectron spectroscopy (XPS). The photocatalytic activities of synthesized $Bi_{25}FeO_{40}$were evaluated by photodegradation of Methylene blue dye. The process variables such as pH, process time, adsorbent dose, and initial Methylene blue concentration were optimized at batch mode and the outcomes demonstrate that $Bi_{25}FeO_{40}$ shows the excellent potential for the photodegradation of Methylene blue dye. The kinetics of dye degradation were evaluated by pseudo-first and second order mechanism. Langmuir and Freundlich isotherm model were successfully applied on experimental data to estimate the adsorption phenomena. .The temperature dependent DC conductivity observed by Arrhenius equation explains the hopping charge mechanism in the $Bi_{25}FeO_{40}$ ceramic.

7.2 **Future Scope**

It was observed Bi based mixed metal oxide is good photocatalyst .

In feature plane, will select the other mixed metal oxide and which show the excited photo catalyst as the good electric properties. We will as see effect of photocatalyst.

The effect of catalytic properties with different synthesis route will be studied.In the present study the catalytic property were studded for pure Bi-based mixed metal oxide .

The doping effect in the catalytic property will be study in future.

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