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SYNTHESIS AND CHARACTERIZATION OF BISMUTH FERRITE (BFO) PREPARED BY AUTO COMBUSTION METHOD FOR PHOTOVOLTAIC APPLICATION

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Abstract:
Herein, we report synthesis and characterization of Bismuth Ferrite (BFO) prepared by Auto Combustion Method. BiFeO3 based materials are currently one of the most studied multiferroics due to their possible applications at room temperature. Multiferroic bismuth ferrite were synthesized using the auto-combustion method. The structural and optical properties were investigated in detail. X-ray diffraction results confirm the formation of BiFeO3 as a major phase with a small number of impurity phases, which will be subsequently removed by adding the dilute nitric acid. X-ray diffraction pattern shows crystalline nature. The average crystallite size was found to be 66nm. In the case of UV-visible absorption spectroscopy (UV-VIS) maximum absorption wavelength of the hump is found to be 308nm. The structural and optical properties of the prepared material have been investigated. The band gap values of found to be 2.7 eV, which will be useful for photovoltaic applications. In addition to this, the spectroscopic diagnosis is carried out with help of the FTIR technique. The absorption peak at 830 cm-1 indicates that the crystalline phase of pure BFO.
Keywords: Bismuth Ferrite (BFO); Optical properties, Auto-combustion method.

1. Introduction:

Multiferroic nanomaterials are materials that can possess several properties like Ferro electricity, ferromagnetism and Ferro elasticity in a single crystal [1-6]. Multiferroic materials have recently attracted a great deal of interest due to the coexistence of different order parameters in a crystalline phase. Thus, it has broad applications in multifunctional, low-power consumption, and environmentally friendly devices [4, 7, 8]. Bismuth ferrite ($BiFeO_3$) has been found to have a ferroelectric phase transition Curie temperature (TC) of 1103 K and a G-type antiferromagnetic phase transition Neel temperature (TN) of 643 K, which are much higher than room temperature [9]. Due to the high TC and TN, BFO becomes the most promising and widely known multiferroic material [7, 9].

Since it is difficult to synthesize BFO without impurity phases. Due to the large surface area and various morphologies, BFO nanostructures exhibit significantly enhanced visible-light photocatalytic ability and magnetization. Moreover, with a low band gap, BFO-based nanomaterials present a strong photovoltaic effect. Because of the remarkable multifunctional properties, BFO-based nanomaterials have attracted great research enthusiasm in recent years. Furthermore, the research enthusiasm will continue in the future.

S. R. Dhanya et al synthesised $BiFeO_3$ powder and studies spectroscopic characteristics and he concluded that sintering temperature of 820^{0}C is best suited for BFO synthesis [10].M. Muneeswaran et al synthesised nanosized $BiFeO_3$ powder whose FT-IR spectra revealed that absorption bands at 555 and 445 cm-1 are due to the stretching vibration of Fe-O and the bending vibration of O-Fe-O bond respectively [11]. Wei Cai et al studied ferroelectric property and band gap in Ti-doped bismuth ferrite and found the band gap of pure BFO is 2.58 eV[12].

In the present communication, we synthesised pure BFO which have focused on the structural and optical properties for photovoltaic application.

2. Experimental procedure:

Bismuth ferrite powder was synthesized by a solution evaporation route. 0.25 M Bi $(NO_3)_3$ and 0.25 M Fe $(NO_3)_3$ solution prepared by dissolving in dilute nitric acid. These two solutions were mixed in a beaker. To this Glycine with mole ratio 0.1 concerning nitrate was added to the above solution. The surfactant added was with a mole ratio of 0.05 with respect to metal. The surfactant used Triton X. This solution was heated on a hot plate under the continuous stirring condition to its boiling temperature until all the liquid evaporated. There was an immense evolution of brown fumes, towards the end of the reaction. A fluffy brown mass was obtained at the base of the beaker. Then the powder was sintered at 700°C for 4 hours.

3. Result and discussion