

UNIVERSITI TEKNOLOGI MARA

**SYNTHESIS AND
CHARACTERIZATION OF
GALLIUM DOPED AND CHITOSAN
ASSISTED MULTIFERROIC
BISMUTH FERRITE BY
HYDROTHERMAL METHOD**

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MSc

May 2021

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

The rapid development and research study towards multiferroic materials which is BiFeO_3 was due to the characteristics possess by the material where it can exists at room temperature which rarely happen for other multiferroic materials. In the present study, the main focus has been dedicated to synthesis pure BiFeO_3 and modified BiFeO_3 via hydrothermal method. Structural, optical and magnetic properties of all samples have been investigated. X-rays diffraction (XRD) study was carried out to determine the phase presence in the materials and the obtained results shows the presence of BiFeO_3 peaks for all samples, pure BiFeO_3 (Ga^{3+} ; $x = 0\%$), 0.24 g Chitosan assisted BiFeO_3 , $\text{Bi}_{1-x}\text{Ga}_x\text{FeO}_3$ ($x = 1\%$, 3% and 5%). For $\text{Bi}_{1-x}\text{Ga}_x\text{FeO}_3$ ($x = 5\%$), a secondary phase which may associated with Bismuth Oxide, Bi_2O_3 was detected from Rietveld refinement analysis via GSAS software. Scanning electron microscope (SEM) analysis was carried out to observe the morphology of all samples pure BiFeO_3 and modified BiFeO_3 where the results show changes in particles size and also all the sample possess agglomeration. The agglomeration was much more controlled and consistent for 0.24 g Chitosan assisted BiFeO_3 . For optical study, the value of band gap obtained for Ga^{3+} doped samples are 1.70 eV ($x = 0\%$), 1.70 eV ($x = 1\%$), 1.82 eV ($x = 3\%$) and 1.78 eV ($x = 5\%$) while for 0.24 g Chitosan assisted BiFeO_3 is 1.16 eV. The analysis of magnetic properties was carried out to determine the effect towards BiFeO_3 before and after modification. The hysteresis loops of anti-ferromagnetic possess by BiFeO_3 shows an improvement when doped with Ga^{3+} and with the assist of 0.24 g Chitosan on BiFeO_3 . The shape of the graph changes gradually from linear to 'S' shapes with the increasing of Ga^{3+} weight percentage. In addition, the coercivity field also decrease from 323.07 G ($x = 0\%$), 33.27 G ($x = 1\%$), 229.73 G ($x = 3\%$), 28.983 G ($x = 5\%$) suggested that the samples have lower losses and can be easily magnetized and demagnetized. Chitosan assisted BiFeO_3 sample show a small value of coercivity which is 20.877 G compared to pure BiFeO_3 which is 323.07 G.

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