International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.08, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

PHOTO-MULTIFERROICS RESPONSE ON BISMUTH FERRITE- A STUDY

Anu Gupta*, Gurmeet Singh Lotey²

Nano Research Lab, Department of Physics, DAV University, Punjab - 144012, INDIA

ABSTRACT

Multifunctional multiferroics have been attracting increasing attention because of their fascinating ferroelectric, magnetic and photovoltaics properties. These materials are called photomultiferroics in thin film form and these exhibits switchable photoelectric response. This makes it interesting for future photovoltaics applications. In this presentation, we will focus on the recent progress in this direction, i.e., how one can control the size, shape of $BiFeO_3$lead to improvement in their photovoltaic properties.Ferroelectrics materials display spontaneous electric polarization because of breaking of Centro-symmetry of unit cell. The polarization in these materials can be change by varying the physical, chemical or mechanical bias. These materials have been widely studying in photovoltaics. Photovoltaic devices are based upon to have driven for the separation of charge carriers in the light absorbing layer. The internal electric field in ferroelectric materials can do this directly, allowing greater flexibility in device design. We are aiming to implement this idea using multiferroic material.

Keywords: Ferroelectrics, Multiferroics, Photovoltaics

1. INTRODUCTION

The increase in the demand of energy has paying great attention to the scientist to develop new and alternate of resources of energy.The natural way of energy harvesting/generating has solvedthe problem of energy production by use of solar cells[1-3].There are several ways to harvest energy from sun. Now a days much attention has been paid to the $BiFeO_3$because of its excellent properties [4-6] and making enable it to be use in various photovoltaic applications. $BiFeO_3$ thin film based-diode shows photovoltaic effects [7-9].

Photo-multiferroic materials possess one or more ferroic order along with the response to visible light. There has been tremendous advancement done to improve power conversion efficiency in photo-ferroelectrics or photo-multiferroics via increasing the absorption of solar spectrum light with the help of narrowingthe bandgap of multiferroic material, $BiFeO_3$.

In the present, a possibility to exploit the use of $BiFeO_3$ as photo-multiferroic has been discussed. Moreover the dependence of photo-multiferroic properties on size, doping and shape is explored.

2. RESULTS AND DISCUSSIONS

It has been found from the structural analysis of the sample that the synthesized nanoparticles exhibits the rhombohedral structure and space group *R*3*c*with JCPDS card No. 86-1518. It has been also found that the synthesized $BiFeO_3$ nanoparticles displaying size-dependent photo-multiferroic property as shown in Figure 1 (c). The Neel temperature, the particle size found to get lowered along with reduction in polarisation with the displacement of cation in the crystallographic [10]. The decrease in the particle size shows a direct relationship between lower polarisation and Neel temperature. Also, the decrease in the particle size leads to decrease in Neel temperature as well as magnetic transition. The nanoparticles with various shape has been synthesize as shown in Figure 1(a,b). The factor temperature and concentration of KOH play an important role in determining the morphology. Nanoparticles with spherical shape has been obtained with 200°C for 8M KOH while at 200°C for 12M KOH microcube formed [11].

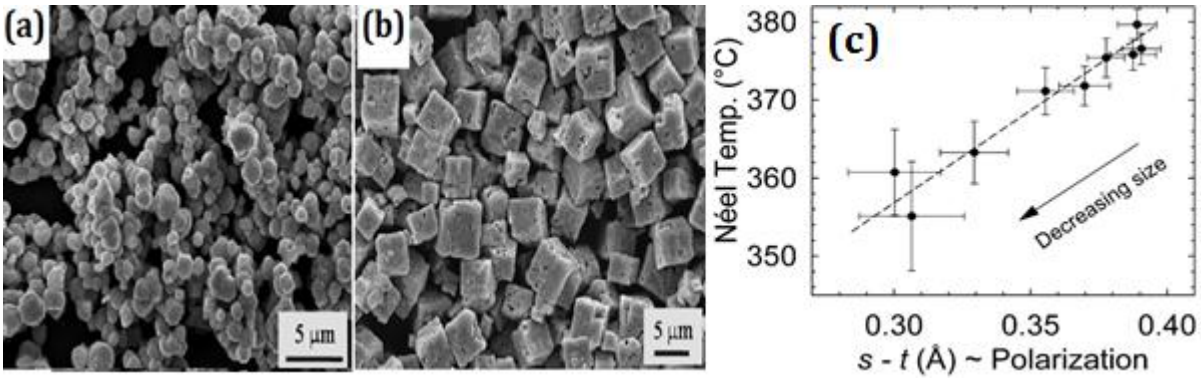

FIGURE 1: SEM micrograph of $BiFeO_3$ powders annealed at 200°C (adopted with permission from ref. [1]).

3. ACKNOWLEDGEMENTS

Dr GS Lotey gratefully acknowledges the Department of Science and Technology (DST), Government of India, for providing funding, to carry out this research work under Indo-Ukraine International project via their sanction letter no. INT/UKR/P-17/2015 dated 14 August 2015. The work is partly supported by the Ministry of Education and Science of Ukraine through Indo-Ukraine International project "Spectroscopy study of multifunctional multiferroics materials" (Protocol MES of Ukraine from 09.09.2015).

REFRENCES

[1] K. Park, M Lee, Y Liu, S Moon, G-T Hwang, G Zhu, JE Kim, SO Kim,DK Kim, ZL Wang, KJ Lee, Flexible nanocomposite generator made ofBaTiO3 nanoparticles and graphitic carbons, Adv. Mater,24, 2012,2999-3004.

[2] DS. Cohan, Energy and environment undergraduate course emphasizing comparative matrics, J. Prof. Issues Eng. Educ. Pract., 137,2006, 64-68.

[3] D Shen, J Park, JAjistaria, SY Choe, HC Wickle, DJKim, The design, fabrication and evaluation of a MEMS PZT cantilever with an integrated Si proof mass for vibration energy harvesting, journal of micromechanics and microengineering,18,2008.

[4] TJPark,GC. Papaefthymiou,AJ. Viescas,AR. Moodenbaugh, Stanislaus S. Wong, NANO LETTERS, 7, 2007, 766-772.

[5] SM. Selbach,TTybell, MA Einarsrud, TGrande,Size-Dependent Properties of Multiferroic $BiFeO_3$ Nanoparticles,Chem. Mater, 19,2007, 6478–6484

[6] S Li,YHua Lin,BPing Zhang,Y Wang, CW Nan,Controlled Fabrication of $BiFeO_3$ Uniform Microcrystals and Their Magnetic and Photocatalytic Behaviors,J. Phys. Chem. C, 114, 2010,2903–2908.

[7] T Choi, S Lee, YJ Choi, V. Kiryukhin, SW Cheong, Switchable Ferroelectric Diode and Photovoltaic Effect in $BiFeO_3$, Science, 324, 2009, 63-66.

[8] SY Yang, LW Martin, SJ Byrnes, TE Conry, SR Basu, D Paran, L Reichertz, J Ihlefeld, C Adamo, A Melville, YH Chu, CH Yang, JL Musfeldt, DG Schlom, JW Ager, R Ramesh, Photovoltaic effects in $BiFeO_3$, Applied Physics Letters, 95, 2009, 1-3.

[9] R Guo, L You, L Chen, D Wu, J Wang,Photovoltaic property of $BiFeO_3$ thin films with 109 domains,Applied Physics Letters, 99, 2011, 1-2.

[10] SM Selbach, T Tybell, MA Einarsrud, TGrande, Size-Dependent Properties of Multiferroic $BiFeO_3$ nanoparticles,Chem. Mater., 26,2007, 6478-6484.

[11] JP Zhou, RL Yang, RJ Xiao, XM Chen, CY Deng, Structure and phase transition of $BiFeO_3$ cubic micro-particles prepared by hydrothermal method, Materials Research Bulletin, 47, 2012, 3630-3636.