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Improvement in photovoltaic response of bismuth ferrite by tuning its ferroelectric and bandgap properties

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ABSTRACT

Pristine and Mn-doped bismuth ferrite samples were prepared by sol–gel method. XRD patterns showed rhombohedral to orthorhombic phase transition with Mn doping in $BiFeO_3$ sample. The surface morphology of the samples was carried out by scanning electron microscope which exhibited a decrease in grain size with Mn doping. Magnetic hysteresis curves exhibit that manganese doping induces modification in magnetic properties of bismuth ferrites. Significant modification was observed in dielectric with Mn doping and maximum value was recorded for $BiFe_{0.8}Mn_{0.20}O_3$ sample. *P–E* hysteresis curves were recorded to evaluate the ferroelectric properties of all samples at room temperature. A significant improvement was observed in ferroelectric properties in doped samples. Bandgap values of $BiFe_{1-x}Mn_xO_3$ in UV–Vis region decreases with Mn doping and minimum for $BiFe_{0.80}Mn_{0.20}O_3$ sample as evaluated from Tauc's plots. *I–V* studies of pristine and Mn-doped samples were carried out with light and without light. Enhanced photocurrent density was observed in Mn-doped BFO samples. Hence, these modifications in ferroelectric and photovoltaic properties of $BiFe_{1-x}Mn_xO_3$ samples make bismuth ferrites a good candidate for photovoltaic applications.

1 Introduction

Multiferroics are the materials which exhibit ferroic (ferroelectric, ferromagnetic and ferroelastic) properties simultaneously. $BiFeO_3$ (BFO) is an important multiferroic material and has applications in wide range of fields like memory storage devices, spintronics and nowadays photovoltaics [1]. BFO has gained attention not only because of its ferroelectric and magnetic properties but also because of its good optical response. BFO has narrow bandgap (~ 2.7 eV) comparative to other ferroelectric materials which lies in ultraviolet–visible (UV–vis) range [2]. It is a great advantage to achieve good

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