Energy Storage Capacity and Electrocaloric Effect on Sn Modified Barium Titanium Oxide ($\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$)

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Research Article

Keywords: X-ray diffraction, Rietveld refinement, Maxwell Relation, Electrocaloric effect

Posted Date: February 23rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-248711/v1>

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Abstract

Modified Barium Titanium Oxide ($\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$) was prepared by using the solid-state reaction method. The crystal structure, energy storage behavior, and electrocaloric properties were studied. The phase purity and structural analysis were investigated using the X-ray diffraction technique and the Rietveld refinement of XRD pattern. The microstructure of the sample was recorded by using the Field Emission Scanning Electron Microscopy (FESEM). The temperature variation dielectric property shows that the ceramic exhibits diffuse phase transition behaviour. The ferroelectric nature in $\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$ has been depicted from P-E loops analysis. The energy storage behaviour and electrocaloric properties were estimated from the temperature variation P-E loops at 40kV/cm. The electrocaloric effect was studied by an indirect method using Maxwell relation, and the electrocaloric value has been estimated to with 94% of energy storage efficiency.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

The (a) XRD pattern and, (b) Rietveld refinement of $\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$

Figure 2

Plot of $\beta\cos\theta$ versus $4\sin\theta$ along with William-Son Hall Plot of $\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$.

Figure 3

FE-SEM micrograph at 10K magnification of $\text{BaTi}_{0.8}\text{Sn}_{0.2}\text{O}_3$.

Figure 4

Please see the Manuscript Doc file for the complete figure caption.

Figure 5

(a) Room temperature field variation Ferroelectric hysteresis loops and (b)Variation of Remnant polarization(P_r), Maximum Polarization(P_{max}), and Coercive field(E_c) with the applied field

Figure 6

Temperature variation ferroelectric hysteresis loops at constant field 40kV/cm with frequency 50Hz

Figure 7

a) First quadrant of temperature variation ferroelectric hysteresis, (b) Schematic diagram of the first quadrant indicating recoverable energy density (W_{rec}) and loss of energy density (W_{loss}) and (c) Variation of W_{rec} , W_{tot} and $\eta(\%)$ with temperature.

Figure 8

Temperature variation ferroelectric hysteresis loops at constant field 40 kV/cm with frequency 50 Hz.

Figure 9

Polarisation vs Temperature curve at constant field 30 kV/cm and 40 kV/cm.