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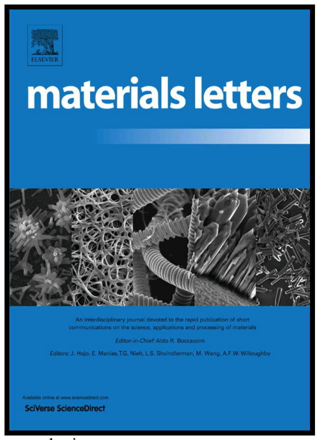

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Electrocaloric Effect in Lead-free Relaxor (1-x)$(Sr_{0.7}Bi_{0.2})TiO_3$+x$(Na_{0.5}Bi_{0.5})TiO_3$ Material System

Jinglei Li[1,2], Xiaobo Zhao[1], Zhuo Xu[2], Tian Zhang[1], Xiaoshi Qian[1], Ying Hou[1], Lu Yang[1], Shujun Zhang[3*]

[1]*Department of Electrical Engineering and Materials Research Institute, The Pennsylvania State University, University Park, Pennsylvania 16802, USA*

[2]*Electronic Materials Research Laboratory, Key Laboratory of the Ministry of Education and International Center for Dielectric Research, Xi'an Jiaotong University, Xi'an 710049, China*

[3]*Institute for Superconducting and Electronic Materials, Australia Institute of Innovative Materials, University of Wollongong, NSW, 2500, AU*

[*]Corresponding author: Tel: +61 242981479. shujun@uow.edu.au

Abstract

The relationship between electrocaloric effect (ECE) and electrostrictive strain over a broad electric field was studied in (1-x)$(Sr_{0.7}Bi_{0.2})TiO_3$+x$(Na_{0.5}Bi_{0.5})TiO_3$ relaxor based lead-free ceramics, where the electric field induced strain can reach the level of 0.28% at 12 MV/m. The experimental data revealed that the composition with highest strain response also generated the largest ECE near room temperature, e.g., ΔS=3.6 J kg^{-1} K^{-1} and an adiabatic temperature change ΔT=2.4 K at 13 MV/m. This research provides an effective approach for designing new ECE materials.

Keywords: Electrocaloric; Electrostrictive Strain; Relaxor; Lead-Free Ceramics.

1. Introduction

The electrocaloric effect (ECE) is the temperature/entropy change of a dielectric material caused by electric field induced polarization change, which has the promise of realizing solid-state cooling devices for a broad range of applications, such as on chip cooling and temperature regulation for sensors and electronic devices. Dielectrics with large ECE provide an alternative approach to the century-old vapor compression based refrigeration technologies, due to the advantages of miniaturization, high efficiency, and environmental friendly[1]. There are currently numerous candidates for ECE materials, but being restricted for practical applications due to the low ECE effect, as given in Table I.