

SW-P001

Effect of Ni dopant on the multiferroicity of BiFeO₃ ceramic

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Multiferroic materials are of great interest because of its potential applications in the design of devices combining magnetic, electronic and optical functionalities. Among various multiferroic materials, BiFeO₃ (BFO) is known to be one of the intensively focused mainly due to the possibility of multiferroism at device working temperature (> 200 °C). However, leakage current and weak polarization resulting from oxygen deficiency and crystalline defect should be resolved. Furthermore the magnetic ordering of pure BFO mainly prefers to have antiferromagnetic coupling. Up to now many attempts have been performed to improve the ferromagnetic and the ferroelectric properties of BFO by doping. In this work, we investigated the effects of Ni substitution on the multiferroism of bulk BFO. Four BFO samples (a pure BFO and three Ni-doped BFO's; BiFe_{0.99}Ni_{0.01}O₃, BiFe_{0.98}Ni_{0.02}O₃ and BiFe_{0.97}Ni_{0.03}O₃) were synthesized by the standard solid-state reaction and rapid sintering technique. The XRD results reveal that Ni atoms are substituted into Fe-sites and give rise to phase transition of cubic to rhombohedral. By using vibrating sample magnetometer and standard ferroelectric tester, the multiferroic properties at room temperature were characterized. We found that the magnetic moment of Ni-doped BFO turned out to be maximized for 3% of Ni dopant.

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Keywords: Multiferroics, Bismuth compounds, Magnetic properties, Antiferromagnetic materials, Ferroelectric materials, Magnetization

SW-P002

Snapshot of carrier dynamics from amorphous phase to crystal phase in Sb₂Te₃ thin film

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Electrons and phonons in chalcogenide-based materials play are important factors in the performance of an optical data storage media and thermoelectric devices. However, the fundamental kinetics of carriers in chalcogenide materials remains controversial, and active debate continues over the mechanism responsible for carrier relaxation. In this study, we investigated ultrafast carrier dynamics in an multilayered {Sb(3Å)/Te(9Å)}_n thin film during the transition from the amorphous to the crystalline phase using optical pump terahertz probe spectroscopy (OPTP), which permits the relationship between structural phase transition and optical property transitions to be examined. Using THz-TDS, we demonstrated that optical conductance and carrier concentration change as a function of annealing temperature with a contact-free optical technique. Moreover, we observed that the topological surface state (TSS) affects the degree of enhancement of carrier lifetime, which is closely related to the degree of spin-orbit coupling (SOC). The combination of an optical technique and a proposed carrier relaxation mechanism provides a powerful tool for monitoring TSS and SOC. Consequently, the response of the amorphous phase is dominated by an electron-phonon coupling effect, while that of the crystalline structure is controlled by a Dirac surface state and SOC effects. These results are important for understanding the fundamental physics of phase change materials and for optimizing and designing materials with better performance in optoelectronic devices.

Keywords: Topological insulator, Sb₂Te₃, Carrier lifetime