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Effects of doping ratio of Cobalt and Iron on the structure and optical properties of ferroelectric bismuth titanates

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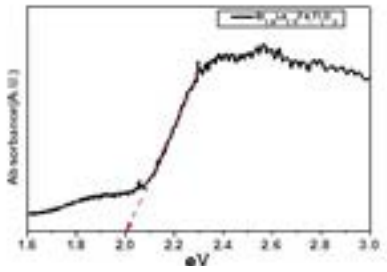
The wide band gap of complex oxides is one of the major obstacles limiting their use in photovoltaic cells. Tunability of the bandgap for ferroelectric complex oxides is one of the key issues for photovoltaic applications. We report doped ferroelectric oxides with narrow bandgaps and photovoltaic effect. To identify an effective route for tailoring the band gap of complex oxides, this study examined the effects of cobalt and iron doping on lanthanum-modified $Bi_4Ti_3O_{12}$-based oxides synthesized using a solid reaction. The structural and optical properties were analyzed by X-ray diffraction and ultraviolet-visible absorption spectroscopy. As a result, the optimal iron to cobalt doping ratio in bismuth titanate powder resulted in ~1.94eV decrease in the optical band gap. In the film form, the optical bandgaps of Co-doped $Bi_{3.25}$ $La_{0.25}$ Ti_4O_{12} (BLT) and Fe, Co- doped BLT films was narrower than that of non-doped BLT by more than 1 eV. Correlated with the bandgap reduction, the Fe,Co-doped BLT film shows largely enhanced the photocurrent density by 25 times that of than BLT films. The density functional theory (DFT) calculation confirms that intermixed transition metal dopants (Fe, Co) in BLT generate novel energy states under conduction band. This new route to reduce the optical bandgap can be adapted to the synthesis of other complex oxides. This approach to tune the bandgap by simple doping could be applied to other wide-bandgap materials, which have the potential to be used in solar energy conversion or optoelectronic applications.



Biography

Chung Wung Bark has completed his PhD from POSTECH, Korea and postdoctoral studies from University of Wisconsin-Madison, USA. He has published more than 150 papers in SCI journals and has been serving as a guest editorial board member.

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