Analysis of magnetoelectric effect in mulitferroic nano-laminate with flexoelectricity

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Abstract

The property of the coupling between electric and magnetic fields in multiferroic (MF) materials is called magnetoelectric (ME) effects, which have received increasing research interests in ME coupling behaviour due to their potential applications in sensors, electric current sensors, harvesters and so on. Generally, the ME effect plays a key role in the performance of MF devices. Therefore, enhancing the ME effect in MF composites and structures is crucial to the applications of MF devices. Flexoelectricity is the phenomenon of electric polarization induced by a strain gradient or an inhomogeneous deformation in a solid. It is an important kind of electromechanical coupling, just like piezoelectricity, which describes the electric polarization induced from a strain. In this contribution we investigate the effect of flexoelectricity on the magnetoelectric (ME) effect in mulitferroic (MF) composites and structures. Taking the flexoelectric effect in the piezoelectric phase into account, we derived the two-dimensional equations to predict the ME effect in a MF composite laminate consisting of piezomagnetic and piezoelectric layers with nano-thickness. The static ME effect in the MF composite bilayer with free boundary conditions under a constant magnetic field is numerically studied. The results indicate that flexoelectricity has tremendous influence on the ME effect in multiferroic composites and structures at nanoscale.

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Keywords: ME effect, flexoelectricity, Multiferroic nano-laminate