Magnetostrictive/electrostrictive fracture of the piezomagnetic and piezoelectric layers in a multiferroic composite: Anti-plane case

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Abstract

The main purpose of the present work is to study the influences of magnetostriction, electrostriction and piezomagnetic/piezoelectric stiffening on the fracture behavior of a layered multiferroic composite. For comparison, it is assumed that there is a crack, parallel to the interface, in each layer. Methods of cosine transform and Cauchy singular integral equations are used to solve the crack problem. Numerical results of the stress intensity factor (SIF) are provided and the computational accuracy is demonstrated. Discussion on the numerical results indicates that the multiferroic composite consisting of cobalt ferrite and barium titanate layers are more prone to fracture under electric loading than under magnetic loading. In the case of magnetostriction, to increase the shear modulus of the piezomagnetic layer would raise the SIF; but to increase that of the piezoelectric layer would reduce the SIF; in the case of electrostriction, inverse results are obtained. Piezomagnetic stiffening can affect the SIF when the composite is under electrostriction; piezoelectric stiffening can influence the SIF if the composite is under magnetostriiction. In addition, it is also revealed that two parallel equal cracks may shield each other even if an interface exists between them.

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