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In-plane fracture analysis on the magneto-electro-elastic interfacial region in a multiferroic composite: Effects of volume fraction

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Abstract. The high temperature and pressure of the hot-pressing process of layered ferromagnetic/ferroelectric (FM/FE) composites inevitably give rise to magneto-electro-elastic (MEE) interfacial regions, where defects such as cracks often aggregate and definitely affect the performance of the composite. Fracture analysis is performed on an MEE interfacial region between an FM layer and an FE layer by the methods of Fourier integral transform and Cauchy singular integral equations. After the numerical computation is verified by the exact solution in a special case and the numerical solutions in existing literature, numerical results of MSERR (mechanical strain energy release rate) and COD (crack opening displacement) are provided to discuss the fracture behavior. The effect of FE volume fraction of the interfacial region on the fracture behavior is demonstrated from three different perspectives. Both material stiffness and constraint effect are used to explain the physical mechanisms. The obtained results may serve as guidelines for the anti-fracture design of FM/FE multiferroic composites. Because the existence of such MEE interfacial regions has been scarcely considered by existing papers, the main novelty of the present work is the incorporation of the MEE interfacial region into the mechanical model of the FM/FE composite.

Keywords: Magneto-electro-elastic interfacial region; Multiferroic composite; In-plane fracture; Volume fraction; Mechanical strain energy release rate; Crack opening displacement.

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