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Stress Intensity Factor of an Interfacial Corner between Anisotropic Bimaterials under Thermal Stress

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Summary

Micro-structures such as those utilized in electronic devices and micro-electro mechanical systems (MEMS) are composed of many different materials. Many interfacial corners exist in electronic devices and MEMS because each of the materials employed has a different configuration. Due to the mismatch of the materialsa?T thermal expansion and elastic properties, the stress concentration at an interfacial corner causes failure. Therefore, the strength of an interfacial corner is very important for the reliability of an electronic product. According to the theory of linear elasticity, asymptotic stress near the tip of a sharp interfacial corner is generally singular as a result of a mismatch of the materialsa?T elastic constants. The singular order and the eigenfunctions are obtained using the Williams eigenfunction method, which depends on the materialsa?T properties and the geometry of an interfacial corner. A numerical method using the path-independent H-integral based on the Betti reciprocal principle was developed to analyze the scalar parameters of an interfacial corner between anisotropic bimaterials by Labossiere [1]. We extended this integral to the thermal anisotropic elastic problem using the body force analogy. The stress and displacement around an interfacial corner for the H-integral are obtained using the finite element analysis. A new definition of the stress intensity factors of an interfacial corner was proposed. The asymptotic solutions of stress and displacement around an interfacial corner are uniquely obtained using these stress intensity factors. These stress intensity factors are directly connected to those of interfacial cracks proposed by Hwu [2] and of homogeneous cracks.

1. Labossiere, P. E. W. and Dunn, M. L. (1999): a?oStress intensities at interface corners in anisotropic bimaterialsa??, Engineering Fracture Mechanics, Vol. 62, pp. 555-575. 2. Hwu, C. (1993): a?oExplicit solutions for collinear interface crack problemsa??, International Journal of Solids and Structures, Vol. 30, pp. 301-312.