Direct Determination of Interfacial Traction-Separation Relations in Chip-Package Systems

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ABSTRACT

Microelectronic devices are multilayered structures with many different interfaces. Their mechanical reliability is of utmost importance when considering the implementation of new materials. The cohesive interface modeling approach has the capability of modeling crack nucleation and growth, provided interfacial parameters such as strength and toughness of the system are available. These parameters are obtained through the extraction of traction-separation relations, through indirect either hybrid numerical/experimental methods or direct experimental methods. The direct method promises to determine the parameters in an unambiguous manner. All methods of extracting traction-separation relations require some local feature of the crack-tip region to be measured.

The focus in this work is on the use of the crack opening displacements measured using infrared crack opening interferometry (IR-COI), which are analyzed and incorporated into the cohesive interface modeling approach. A series of mode-I experiments that were performed on laminated silicon/epoxy/silicon interface specimens are described where crack growth and normal crack opening displacements (NCOD) were measured. Global measurements of load/displacement provide the J-integral as a function of the NCOD at the end of the cohesive zone. The path independence of the J-integral then allows the cohesive traction-separation relation for the interface to be extracted by differentiation. Results are compared with analytical and numerical models.

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