Modified Decohesion Test (MDT) to Determine Interfacial Fracture Toughness in Thin Metal Films

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OBJECTIVE

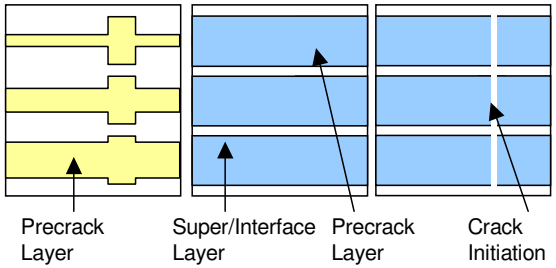
- To characterize interfacial fracture toughness of thin film metal interfaces for the prediction and/or design against interfacial delaminations in electronic and MEMS packages.
- To develop a test that can meet the requirements of:
  - Toughness can be measuremed using a single sample
  - Any mode mix can be generated
  - Sample preparation is simple
  - A mechanics based analytical solution exists
  - A representative interface is created (i.e. use IC fabrication techniques)

APPROACH

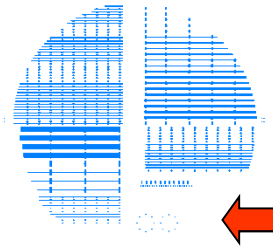
- Using IC fabrication techniques test strips are fabricated on a substrate creating the interface
- Crack surface area is varied for each test strip such that many energy release rates are created on a single test sample
- A highly stressed super layer is used to cause delamination
- The energy release rate below and above the point of delamination are used to bound the interfacial fracture toughness
- Test parameters (film thickness, super layer stress, test strip width, etc.) are correlated to the energy release rate using a mechanics based analytical solution

ACCOMPLISHMENTS:

- Created an analytical model to calculate energy release rate for intrinsically stressed, thermally loaded, anisotropic thin film plates.
- Developed, validated, and patented MDT (Provisional Patent GTRC ID 2682 for Modified Decohesion Test, May 2002).
- Measured interfacial fracture toughness for a Ti/Al_2O_3 interface for a mode mix of 14°
- Applied Ti/Al_2O_3 interfacial toughness measurement to a numerical parametric study addressing changes in an adhesive metal layer to help prevent delamination in stress engineered high density interconnect applications.



MDT steps



SEM of MDT test site

Actual Precrack layer Mask