

Experimental characterization of interfe delamination in microsystems

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Experimental characterization of interface delamination in microsystems

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Introduction

The increasing demand for **multi-functionality** and **miniaturization** in semiconductor industry led to the emergence of System In Package (SIP) solutions. Since SIP systems consist of multiple thin stacked layers manufactured using different materials and processes, **internal mismatch stresses** are almost always present which promote **interfacial delamination** as a dominant failure mode.

Objective

To develop a generic experimental methodology to characterize interfacial delamination in bi/multi-layer structures under mixed mode loading conditions.

Approach & Results

Three complementary techniques are being developed:

I. Miniature Mixed Mode Bending setup (MMMB)
MMMB loading is combined with a new lever mechanism to develop a new MMMB setup (Fig. 1) to carry out *in-situ* delamination experiments under optical, scanning electron microscopes.

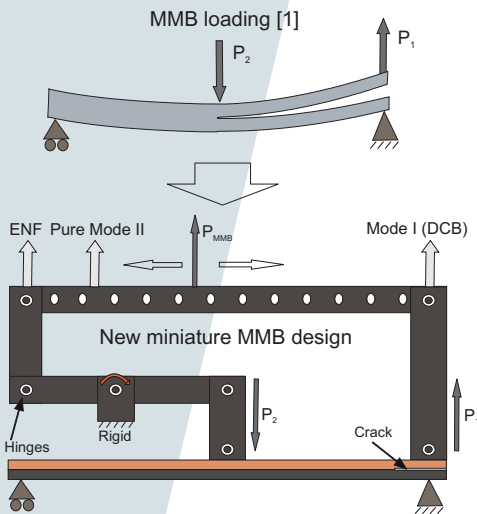


Figure 1 Schematic of new MMMB setup.

Several modifications are adapted to achieve various advantages in new MMMB (Fig. 2).

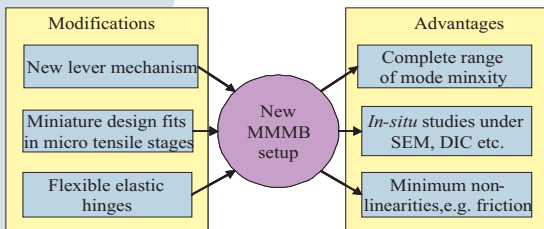


Figure 2 Modifications and advantages in new MMMB setup.

The applied load P_{MMMB} can be decomposed into a pure double cantilever beam (P_{DCB}) and end notch flexure (P_{ENF}) loads (Fig. 3) useful in G_{MMMB} calculations.

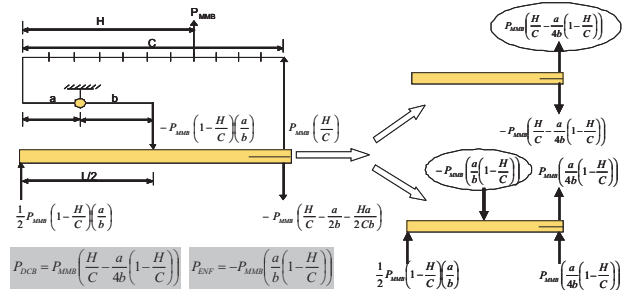


Figure 3 Decomposition of MMMB load into DCB and ENF loads.

II. Surface Load Delamination setup (SLD)

This test is conceptualized to carry out delamination at one scale lower than the MMMB test. The aim is to trigger delamination by application of a controlled surface load (Fig. 4) by, a) stretching the elastic substrate b) gluing of sample c) releasing the substrate in controlled way.

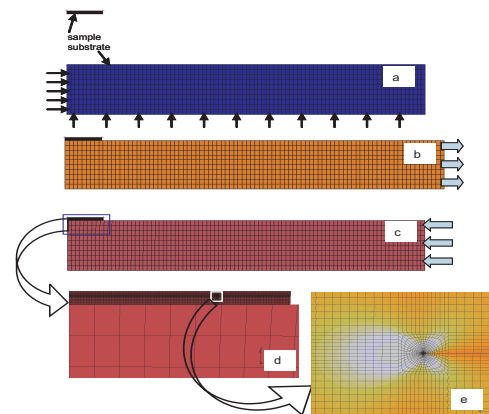


Figure 4 Sequence of the steps in the SLD experiment (fig. a, b, c). The crack region is enlarged to show the σ_{12} stress field ahead of the crack tip (fig. d, e).

III. Microscale Cyclic Delamination setup (MCD)

In this approach fatigue loading is applied in micro scale structures by using integrated MEMS-like actuator mechanisms e.g., by Magnetostriction (Terfenol-D) or Electrostriction (PZT).

Conclusions

- New miniature mixed mode bending (MMMB) setup has been prepared.
- SLD test is simulated in FEM and the setup has to be made.

Future work

- Calibration and validation of MMMB setup.
- Experiments on industrially relevant samples.
- FE analysis and preparation of SLD setup.
- Feasibility study of MCD test setup.

References:

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