Introduction

Interfacial failure, in the form of delamination, is one of the most prevalent issues in microsystems which consist of multiple thin and stacked layers (see figure 1). Here, a cohesive zone model (CZM) is employed for the prediction of delamination.

Solution jump problem

Discontinuities in the numerical solutions of rate independent models are referred to as solution jumps. This problem can be avoided by sufficiently refining the mesh, as shown in figure 2.

However, for realistic interface parameters, i.e. small size of the process zone in brittle interfaces in comparison with other dimensions, the element size has to be extremely small, which results in high computational costs.

Enriched cohesive zone model

The separation approximation of cohesive zone elements in the process zone is enriched by a piece-wise linear function in order to reduce oscillations such as those observed in the DCB test without need for further mesh refinement or application of complicated path-following approaches (see figures 3,4). The formulation of bulk elements is enriched as well. The values of crack tip position, $\alpha$, and enrichment scaling factors, $h/t$, are driven by the deformation process.

Results: mode I delamination

Considering one bulk and one C.Z. element with separation only in normal direction, the cohesive zone opening profile is determined by prescribing the crack tip degree of freedom at fixed positions (see figure 5).

Conclusions and remarks

- Piece-wise linear enrichment can be used to improve the efficiency and robustness of a CZM.
- Further steps should be taken to complete the implementation of the proposed enrichment.

References