MAE Seminar Series

DETERMINATION OF INTERFACE STRENGTH OF BIMATERIAL JOINTS

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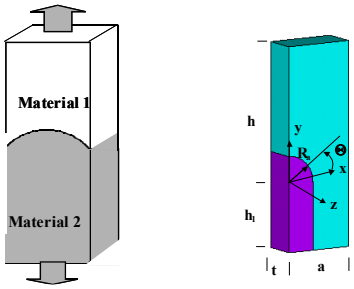
The stress distribution along a curved interface between two different polymer materials is calculated by a 3D finite-element analysis. Such geometry (cf. Fig. 1) of a specimen was proposed in [1] to determine the adhesion strength between two different materials. In dependence on the material stiffnesses and the geometry at the specimen edge (where the two materials form a wedge) there may or may not exist stress singularities for elastic behavior of the components. In case that under tensile loading of such a bimaterial specimen the stress singularities disappear at the wedge, the measured critical force can be used to determine the adhesion strength as a material property.

By using the general analytical solution for the stresses of the bimaterial wedge problem the finite-element modeling provides the power of the stress singularity by a regression analysis of the variation of stresses with the distance from the edge. Furthermore, the stresses are known within the whole specimen.

If the stress singularity disappears a uniform stress field develops during tensile loading of such curved bimaterial specimens. With the calculated maximum normal stress concentration that develops at the pole of the interface and the experimental determined critical force for debonding initiation, the adhesion strength can be determined.

The power of stress singularity at the edges and stress distribution along the interface of a special polymer-polymer composite, consisting of thermoplastic polyurethane and polycarbonate, is derived and discussed. The calculations are realized by using ANSYS 8.1® (PLANE82-elements). From the calculated stress concentration factors it becomes evident that a circle like interface also shows no stress singularities at the edges for this material combination. Calculation results of stress distributions and experimental data are presented. To avoid additional stress concentrations at the surfaces, where a 90° joint exists, a double curved specimen is discussed.

Fig. 1: Curved interface tensile test



[1] B. Lauke, T. Schüller, K. Schneider, Determination of interface strength between two polymer materials by a new curved interface tensile test, Composite Interfaces, 10 (2003) 1-15.

206 Furnas Hall
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Please contact Dr. Robert Wetherhold (mecrcw@buffalo.edu) for additional information.