CRACK PATH DEVIATIONS IN THERMAL LASER SEPARATION – EXPERIMENT AND SIMULATION

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Thermal laser separation is used for non-ablative cutting of silicon wafers and solar cells by utilizing thermally induced mechanical stresses. The process yields excellent edge qualtiy due to melt free and residual free cutting. In this work we address effects which lead to deviations of crack paths while cutting asymmetric substrates. For cutting narrow stripes from wafers or solar cells a deviation of the crack path towards the wafer edge is observed. In addition, the crack path deviates from its ideal path near the wafer end. We present a simulation approach to model the laser absorption and cooling as well as the resulting mechanical stresses on crack tips in the material.
Laser absorption and the cooling is treated in a transient way to incorporate the effects of thermal conduction as well a temperature dependent changes of material parameters. Subsequently, a static analysis is done on predefined crack tips to analyze occurring stresses, the stress intensity factors K_I, K_{II}, K_{III} as well as the angle of the most likely crack propagation. The model is used to reproduce effects like crack deviation in asymmetric substrates and near the wafer end. Experimental and simulation results are compared and possible solutions for to overcome the crack deviations are discussed.

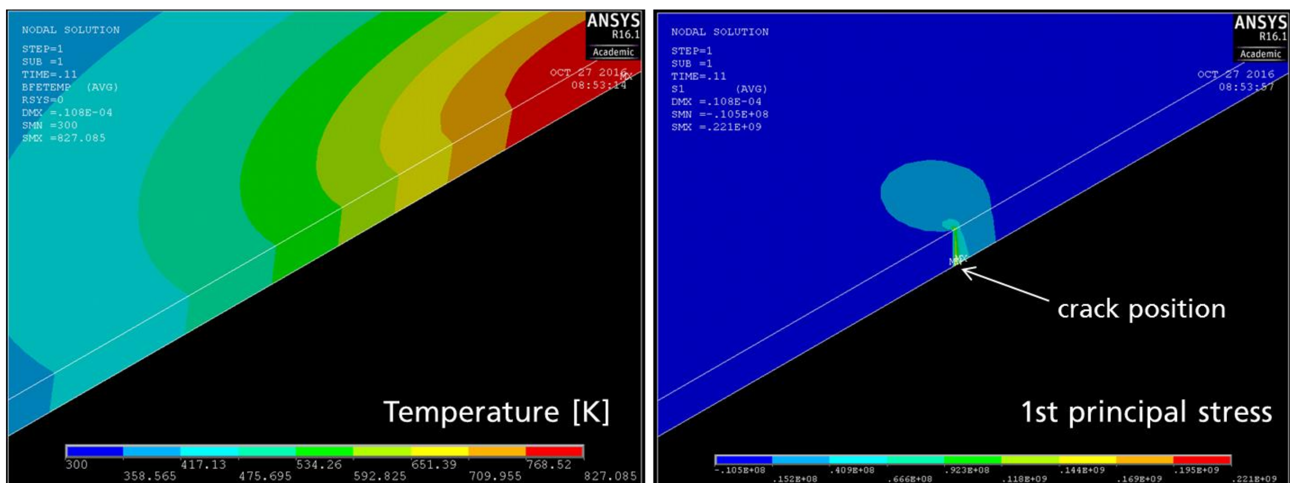

Figure 1, exemplary simulation result: temperature distribution and first principal stress during TLS process