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Delamination in viscoelastic materials with thermal effects

This contribution deals with the analysis of a model describing a rate-independent delamination process along a prescribed interface. The material properties in the bulk are considered to be viscoelastic and temperature-dependent. In the spirit of continuum damage mechanics the delamination process is modeled with the aid of an internal delamination variable z. The related PDE system, which couples the displacements, the absolute temperature and the delamination variable, has a highly nonlinear character and features frictionless Signorini conditions on the interface. The goal is to obtain the existence of weak solutions in the setting of brittle delamination, where the delamination variable takes the values 0 or 1, only, and where the crack is described in terms of a transmission condition being a local, nonconvex constraint, which links the displacements and the delamination variable in a very rigid manner. In order to deduce this existence result the brittle model is consecutively approximated by suitably regularized problems: On the one hand, the property $z \in \{0, 1\}$ is gained from a Modica-Mortola functional; on the other hand, the rigid transmission condition is approximated by a surface energy term for so-called adhesive contact, which penalizes displacement jumps outside the crack set but does not rigidly exclude them. Hence, the analysis involves three different coupled free boundary problems for the delamination variable and the displacements, featuring the evolution of the crack set along the interface.
This is joint work with Riccarda Rossi (Università di Brescia).