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# Effect of kinematic hardening on localized necking in substrate-supported metal layers

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## Abstract

Prediction of necking limits in thin substrate-supported metal layers, which are typically used as functional components in electronic devices, represents nowadays an ambitious challenge. The specific purpose of the current work is, first, to numerically investigate the effect of kinematic hardening on localized necking in a freestanding metal layer. Second, the impact of adding a substrate layer on the ductility evolution of the resulting elastomer/metal bilayer will be analyzed. The materials in the metal and substrate layers are assumed to be isotropic, incompressible and strain-rate independent. The behavior of the metal layer is described by a rigid-plastic model with mixed (isotropic and kinematic) hardening. The isotropic hardening contribution is modeled by the Hollomon law, while kinematic hardening is modeled by the Armstrong-Frederick law. The substrate layer is made of elastomer material whose mechanical behavior is assumed to be hyperelastic and modeled by a neo-Hookean constitutive law. The Marciniak-Kuczynski imperfection analysis is used to predict plastic flow localization. Through various numerical simulations, the influence of kinematic hardening on localized necking as well as the impact of the addition of an elastomer layer are specifically emphasized. Comparisons with experimental results are also carried out to assess the

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