www.elsevier.com/locate/ijmecsci

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

Mohamed Ben Bettaieb, Farid Abed-Meraim

PII: S0020-7403(16)30967-5
DOI: http://dx.doi.org/10.1016/j.ijmecsci.2016.12.002
Reference: MS3514

To appear in: *International Journal of Mechanical Sciences*

Received date: 26 February 2016
Revised date: 9 October 2016
Accepted date: 1 December 2016

Cite this article as: Mohamed Ben Bettaieb and Farid Abed-Meraim, Effect o kinematic hardening on localized necking in substrate-supported metal layers *International Journal of Mechanical Sciences* http://dx.doi.org/10.1016/j.ijmecsci.2016.12.002

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

Mohamed Ben Bettaieb[a,b], Farid Abed-Meraim[a,b]

[a]LEM3, UMR CNRS 7239 – Arts et Métiers ParisTech, 4 rue Augustin Fresnel, 57078 Metz Cedex 3, France

[b]DAMAS, Laboratory of Excellence on Design of Alloy Metals for low-mAss Structures, Université de Lorraine, France

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