Analysis of Damage and Fracture Mechanisms in Ductile Metals under Non-Proportional Loading Paths

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ABSTRACT

The presentation discusses biaxial experiments and corresponding numerical simulations to analyze the effect of non-proportional loading paths on damage and fracture behavior of ductile metals. Newly developed specimens are taken from thin metal sheets and are tested under different biaxial loading conditions covering a wide range of stress states [4]. In this context, an anisotropic continuum damage model is presented based on yield and damage conditions as well as evolution laws for plastic and damage strain rates. Different branches of the damage criteria are taken into account corresponding to various damage and failure processes on the micro-level depending on stress triaxiality and Lode parameter [1, 2, 3]. Experiments with the biaxially loaded X0- and H-specimens have been performed. Results for proportional and corresponding non-proportional loading histories are discussed. During the experiments strain fields in critical regions of the specimens are analyzed by digital image correlation (DIC) technique while the fracture surfaces are examined under scanning electron microscope (SEM). Numerical simulations of the experiments have been performed and numerical results are compared with experimental data. In addition, based on the numerical analyses stress distributions in critical specimen’s areas are detected. The results demonstrate the efficiency of the new specimen’s geometries covering a wide range of stress states in the shear/tension and shear/compression regime as well as the effect of loading history on damage and fracture behavior in ductile metal sheets.

REFERENCES