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Ductile Fracture of Anisotropic Aluminum Extrusions under Multi-axial Loading: Experiments and Modeling

by

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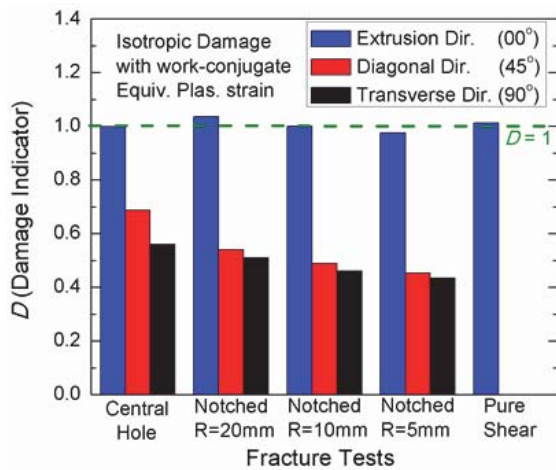
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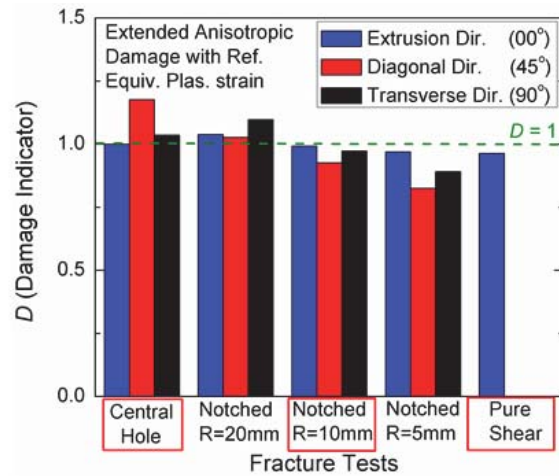
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Isotropic Model



Anisotropic Model

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Ductile Fracture of Anisotropic Aluminum Extrusions under Multi-axial Loading: Experiments and Modeling

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Abstract

The anisotropic ductile fracture of a 6260-T6 anisotropic aluminum alloy extrusion is investigated using a hybrid experimental-numerical approach. A basic fracture testing program covering a wide range of stress states and different material orientations is carried out. It comprises experiments on notched tensile specimens, tensile specimens with a central hole and butterfly shear specimens. The surface strain fields are obtained using two-dimensional Digital Image Correlation (DIC), while detailed finite element simulations are performed of all experiments to determine the local stress and strain histories inside the specimens. The analysis shows that the use of the newly-proposed extension of the Yld2000 yield function for three-dimensional stress states (see companion paper) together with an isotropic hardening law is able to predict the elasto-plastic behaviors of the present anisotropic aluminum alloy in all experiments. The experimental results show a strong dependency of the strain to fracture on the material orientation with respect to the loading direction. An uncoupled non-associated anisotropic fracture model is proposed which makes use of a stress state dependent weighting function and an anisotropic plastic strain measure. The latter is obtained from applying the von Mises equivalent plastic strain definition after the linear transformation of the plastic strain tensor. It is shown that the use of the isotropic Modified Mohr-Coulomb (MMC) stress state weighting function in this anisotropic fracture modeling framework provides accurate predictions of the onset of fracture for all thirteen fracture experiments.

Keywords: Ductile fracture, aluminum extrusions, anisotropy, Modified Mohr-Coulomb, stress triaxiality, Lode angle
