Experimental and Numerical Analysis on the Formability of a Heat-Treated AA1100 Aluminum Alloy Sheet

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Abstract

The objective of this work is to experimentally and numerically determine the influence of plastic anisotropy on the forming limit curve (FLC) for a heat-treated (300 °C-1 h) AA1100 aluminum alloy sheet. The FLCs were obtained by the Nakajima test, where the anisotropy effect on the FLC was evaluated using hourglass-type samples taken at 0°, 45°, and 90° with respect to the sheet rolling direction. The effect of crystal orientations on the FLC is investigated using three micro-macro averaging schemes coupled to a Marciniak and Kuczynski (MK) analysis: the tangent viscoplastic self-consistent (VPSC), the tuned strength αVPSC, and the full-constraint Taylor model. The predicted limit strains in the left-hand side of the FLC agree well with experimental measurements along the three testing directions, while differences are found under biaxial stretching modes. Particularly, MK-VPSC predicts an unexpected limit strain profile in the right-hand side of the FLC for samples tested along the transverse direction. Only MK-αVPSC, with a tuning factor of 0.2, predicts satisfactorily the set of FLC measurements. Finally, the correlation of the predicted limit strains with the predicted yield surface by each model was also discussed.