11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Modelling of Biaxial Deformation Behavior in an Aluminium Alloy Sheet using Homogenized Crystal Plasticity Finite Element Method

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Key Words: *Crystal Plasticity, Biaxial Deformation, Aluminium Alloy Sheet, Cube Texture.*

In order to analyse elastoplastic deformation behavior of aluminium alloy sheets, very precise biaxial tensile test has been studied [1]. Accurate stress-strain curve, yield loci and forming limit diagram measured by the biaxial tensile test are useful not only for failure prediction in plastic forming, but also for identification of the yield function which is used in finite element analysis. However, since the elastoplastic deformation behavior of the aluminium alloy strongly depends on its microstructure, such as crystal grain size and texture, microstructure-based finite element modelling and simulation will be an effective tool for predicting the biaxial tensile deformation of the aluminium alloy. In this study, in order to simulate the biaxial tensile deformation behavior of the aluminium alloy on the basis of the microstructure, we developed a program code for the crystal plasticity finite element (CPFE) analysis based on the mathematical homogenization method [2]. Using the developed code, the CPFE simulations of the biaxial tensile tests of the aluminum alloy with different density cube textures were performed. Though the CPFEM simulations, effect of the differences in the cube texture density on the differential work hardening of the alloy was investigated. Furthermore, by conducting quantitative comparison between the CPFE simulation results and the experimental results obtained from the biaxial tensile test [3], the hardening model and parameters used in the CPFE simulation were identified.

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