결정소성모델을 적용한 알루미늄 압출관재의 액압성형 해석

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Crystal plasticity simulation of aluminum extruded tube in hydroforming process

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Abstract

Selection of load and end feeding amount will affect the formability of tube in tube hydroforming process. The influence of these parameters was studied by Imaninejad et al.(2004), Ray and MacDonald(2004), Aue-U-Lan et al.(2004), Johnson et al.(2004), Hsu(2003), and Fann and Hsiao(2003), Most recently, researchers studied failure phenomenon due to local instability during tube hydroforming. Prediction of failure initiation using finite element method and applying stability criteria was investigated by Aydemir et al.(2005), Kulkarni et al.(2004), Kim and Kang(2004), and Kim et al.(2004,2003). Phenomenological models have been used widely in the numerical simulations of tube hydroforming. However, very few papers in the literature consider implementing crystal plasticity into FE simulation for the analysis of real size complex metal forming processes such as tube hydroforming to predict both stress-strain response and the evolution of crystallographic texture. In this study, a rate-dependent crystal plasticity model was used to predict anisotropic deformation response of an extruded aluminum tube during hydroforming. Free bulge test of an Al tube was conducted and the strain distribution was measured by the digital image correlation method. Also, texture developments were analyzed by the electron back-scattered diffraction(EBSD) to prove the predictive capabilities of the constitutive model. The rate-dependent crystal plasticity model was implemented into the user-subroutine UMAT of a finite element program ABAQUS. The texture development and strain distribution of the tube obtained by using the crystal plasticity model show a good agreement with experimental results.

Key Words : Crystal Plasticity, Tube hydroforming, Texture, Aluminum extruded tube

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