Analysis of the microstructural evolution of an Al 7075-T651 alloy during ECAP based on continuous dynamic recrystallization

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In this paper, microstructural evolution of an annealed equal channel angular pressed, ECAPed, Al7075-T651 alloy, in terms of average grain size and dislocation density, were evaluated by mean of the continuous dynamic recrystallization (CDRX)-based model proposed by Bacca et al. [1]. For that purpose, annealed samples were subjected to three ECAP passes at room temperature by route A in order to improve the mechanical properties due to the characteristic grain refinement provided by this technique. These experiments were performed inside an ECAP tooling with square cross section channels intersected at 90º and without any fillet radii. Vickers microhardness and uniaxial compression tests were realized to evaluate the material before and after pressing to evaluate the material strengthening. The initial average grain size in the as-annealed condition was measured through optical microscopy. Then, plane strain finite-element, FE, models will be developed by using the commercial ABAQUS/Standard program including the implementation of the CDRX model above mentioned with the help of a user material subroutine. The predictions of interesting material microstructural parameters, pressing force and effective plastic strain after each deformation pass were also evaluated in terms of flow behaviour by comparison between von Mises and Drucker's isotropic yield criteria. The experimental and numerical results revealed that it was possible to obtain a consistent evaluation of microstructural modifications in Al 7075-T651 alloy during ECAP and an appropriated correlation with adopted yield criteria.

[1] M. Bacca, D. R. Hayhurst, R.M. McMeeking, Mech. Mater. **90**, (2015) 148.