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Influence of die construction on equivalent strain, microstructures, and tensile properties of 5052 aluminum alloy processed by groove pressing

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ABSTRACT

Fabrication of ultrafine grained (UFG) metallic materials by imposing severe plastic deformation (SPD) is currently of great scientific interest due to their unusual mechanical properties, and several methods have been introduced for this purpose. Constrained groove pressing (CGP), originally proposed by shin et al., is a novel approach by pressing a plate or sheet metal with asymmetrically grooved dies and flat dies alternatively. Based on the investigation of shin et al., Krishnaiah et al. processed commercial purity aluminum and copper by utilizing unconstrained grooved dies and unconstrained flat dies, which can be named unconstrained grooved pressing (UGP), where the specimen edges are allowed to stretch or contract along the *x*-direction and *y*-direction. The effectiveness of CGP and UGP in reducing grain sizes has been demonstrated, but most of the studies neglected the influence of die construction. Therefore, plastic strains of commercial 5052 aluminum alloy under CGP and UGP are investigated *via* finite element simulations (FES) in this study. Furthermore, microstructures and tensile properties of the processed 5052 Al were investigated and were correlated with the von Mises equivalent strain predicted from FES. Results show that CGP has a higher accumulative rate of equivalent strain and final equivalent strain than UGP and is more beneficial to grain refinement and formation of equiaxed grains. Tensile experiments reveal that the sheets processed by CGP have much better comprehensive mechanical properties.

KEYWORDS: groove pressing, 5052 aluminum alloy, equivalent strain, grain refinement, tensile properties