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Finite Element Modeling and Mechanical Properties of Aluminum Proceed by Equal Channel Angular Pressing Process

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Abstract : During the last decade ultrafine grained (UFG) and nano-structured (NS) materials have experienced a rapid development. In this research work finite element analysis has been carried out to investigate the plastic strain distribution in equal channel angular process (ECAP). The magnitudes of standard deviation (S. D.) and inhomogeneity index (Ci) were compared for different ECAP passes. Verification of a three-dimensional finite element model was performed with experimental tests. Finally the mechanical property including impact energy of ultrafine grained pure commercially pure Aluminum produced by severe plastic deformation method has been examined. For this aim, equal channel angular pressing die with the channel angle, outer corner angle and channel diameter of 90°, 20° and 20 mm had been designed and manufactured. Commercial pure Aluminum billets were ECAPed up to four passes by route BC at the ambient temperature. The results indicated that there is a great improvement at the hardness measurement, yield strength and ultimate tensile strength after ECAP process. It is found that the magnitudes of HV reach 67 HV from 21 HV after the final stage of process. Also, about 330% and 285% enhancement at the YS and UTS values have been obtained after the fourth pass as compared to the as-received conditions, respectively. On the other hand, the elongation to failure and impact energy have been reduced by 23% and 50% after imposing four passes of ECAP process, respectively.

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