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Low Plastic Deformation Energy to Induce High Superficial Strain on AZ31 Magnesium Alloy Sheet

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Abstract : Magnesium alloys have generated great interest for several industrial applications because their high specific strength and low density make them a very attractive alternative for the manufacture of various components; however, these alloys present a limitation with their hexagonal crystal structure that limits the deformation mechanisms at room temperature likewise the molding components alternatives, it is for this reason that severe plastic deformation processes have taken a huge relevance recently because these, allow high deformation rates to be applied that induce microstructural changes where the deficiency in the sliding systems is compensated with crystallographic grains reorientations or crystal twinning. The present study reports a statistical analysis of process temperature, number of passes and shear angle with respect to the shear stress in severe plastic deformation process denominated 'Equal Channel Angular Sheet Drawing (ECASD)' applied to the magnesium alloy AZ31B through Python Statsmodels libraries, additionally a Post-Hoc range test is performed using the Tukey statistical test. Statistical results show that each variable has a p-value lower than 0.05, which allows comparing the average values of shear stresses obtained, which are in the range of 7.37 MPa to 12.23 MPa, lower values in comparison to others severe plastic deformation processes reported in the literature, considering a value of 157.53 MPa as the average creep stress for AZ31B alloy. However, a higher stress level is required when the sheets are processed using a shear angle of 150°, due to a higher level of adjustment applied for the shear die of 150°. Temperature and shear passes are important variables as well, but there is no significant impact on the level of stress applied during the ECASD process. In the processing of AZ31B magnesium alloy sheets, ECASD technique is evidenced as a viable alternative in the modification of the elasto-plastic properties of this alloy, promoting the weakening of the basal texture, which means, a better response to deformation, whereby, during the manufacture of parts by drawing or stamping processes the formation of cracks on the surface can be reduced, presenting an adequate mechanical performance.

Keywords : plastic deformation, strain, sheet drawing, magnesium
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