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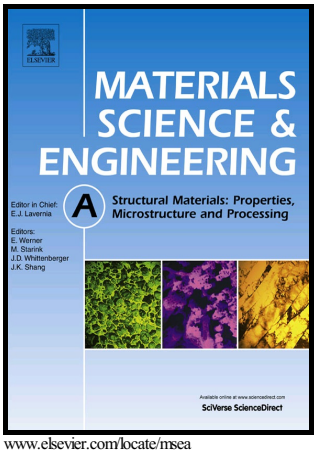

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A Study on Fracture Toughness and Strain rate Sensitivity of Severely deformed Al 6063 alloys processed by Multiaxial Forging and Rolling at Cryogenic Temperature

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Abstract

In the present work, strain rate sensitivity, using tensile and compression test data at different strain rates, fracture toughness using three-point bend test on multi axially forged (MAF) 6063 Al alloys at liquid nitrogen temperature have been investigated. The hardness, tensile strength and strain rate sensitivity (SRS) of the deformed alloy have increased to 116 HV, 337 MPa, and 0.02, from 60 HV, 220 MPa and 0.004 respectively, due to accumulation of high dislocation density in the alloy processed multi axial forging at cryo temperature. Large plastic strain induced during cryo forging of 6063 Al alloy led to effective fragmentation of grains, facilitating grain refinement in the alloy. The cryoforged alloy exhibits multimodal microstructure composed of nanocrystalline, ultrafine and coarse grains. The fracture toughness of deformed (MAF and CR) 6063 Al alloy has been increased from 8.32 MPa $m^{1/2}$to 13.78 MPa $m^{1/2}$ due to grain refinement and high fraction of grain boundaries. The reduction in dimple size with increasing strain showed the presence of fine grains in multiaxial forged 6063 Al as evident from fractography studies.

*Keywords:*Ultrafine grained materials; Strain rate sensitivity; Strain hardening; Coefficient; Fracture toughness