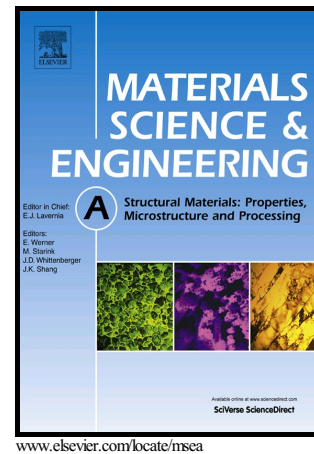


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Deformation Behavior of Ultrafine Grained A356 Material Processed by Cryorolling and Development of Johnson–Cook Model

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Abstract

The present research work focuses on understanding the deformation behavior of cryorolled A356 material at various strain rates ranging from 0.001 s^{-1} – 10 s^{-1} in the temperature range of $25 \text{ }^{\circ}\text{C}$ – $400 \text{ }^{\circ}\text{C}$. Microstructure of the material at each deformation temperature was characterized to completely analyze the material's behavior. Presence of ultrafine grained microstructure with highly unstable dislocation networks were found to play a major role in strengthening the material up to the deformation temperature of $200 \text{ }^{\circ}\text{C}$. Recrystallization and thermal softening decreases the material's strength at deformation temperatures beyond $200 \text{ }^{\circ}\text{C}$. With respect to the rate of deformation, a prominent change in the deformation mechanism is observed at strain rates higher than 1 s^{-1} . The failure mechanism at various strain rate and temperature ranges is studied in detail. Finally a constitutive Johnson-Cook model is developed to predict the material's flow behavior for the range of strain-rates and temperatures under study.

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