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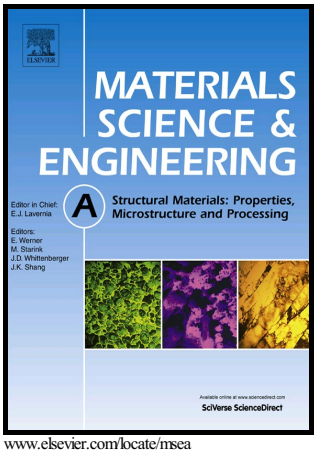

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ACCEPTED MANUSCRIPT

Effect of heat-treatment on microstructural evolution and mechanical behaviour of severely deformed Inconel 718

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Abstract

Severe plastic deformation (SPD) techniques impose very high level of strains and it can enhance the strength of a material several folds. In the current work, Inconel 718 alloy was severely deformed by machining process resulting in inherently "bi-modal" grain size distribution consisting of sheared zone with nano-structured grains and moderately refined grain zone. Hardness of machined chips were found to be much higher than that of bulk and increased further upon giving heat-treatment because of precipitation of γ" and γ' nano-precipitates. However, as with most severely deformed materials, ductility of the machined chip is known to be very low, primarily because of the presence of large fractions of dislocation-saturated nano-structured grains which hinder any more dislocation generation or movement. In this work, we gave short heat-treatment to these deformed samples at elevated temperature to ensue controlled recrystallization in the sheared zone. However, heat-treatment is also expected to result in coarsening of precipitates as well as the grains of the matrix. This phenomenon may, not only reduce the strength, but may also reduce the pinning ability of the precipitates which endow the microstructure with thermal stability. Hence, the specific objective of this work is to understand the interplay of grain boundary pinning and recrystallization, both of which occur at elevated temperatures. Short heat-treatment of the severely deformed samples was performed for 15 minute between 700 °C to 900 °C. It was found that temperatures up to 800 °C do not lead to appreciable recrystallization, while 900 °C heat-treatment can cause appreciable recrystallization, albeit, limited to the shear zone. Size of precipitates was also found to grow with increasing temperature, nonetheless, samples heat-treated at 900 °C were found to be

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