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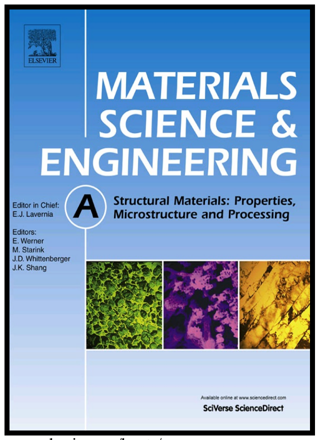

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Controlling the high temperature mechanical behavior of Al alloys by precipitation and severe straining

C.M. Cepeda-Jiménez[a*], M. Castillo-Rodríguez[a], J.M. Molina-Aldareguia[a], Y. Huang[b], T.G. Langdon[b], M.T. Pérez-Prado[a]

[a] IMDEA Materials Institute, C/ Eric Kandel, 2, 28906 Getafe, Madrid, Spain

[b] Materials Research Group, Faculty of Engineering and the Environment, University of Southampton, Southampton SO17 1BJ, UK

[*]Corresponding author.

Abstract

The aim of this work was to investigate the influence of the precipitate distribution on the microstructure and on the room and high temperature mechanical properties of an age-hardenable aluminium AA6082 alloy following severe straining by high-pressure torsion (HPT). With this goal, specimens in the as-cast and T6 peak-aged conditions were processed by HPT using 0.5, 1 and 5 turns at room temperature. At high strain levels (γ>100), similar saturation grain sizes (~250 nm), high-angle boundary fractions (~80%) and hardness values (Hv~160) were obtained for both initial conditions. Grain refinement led to significant strengthening and to good ductility values at room temperature. Analysis by TEM and EDS elemental mapping revealed that HPT processing of the as-cast condition led to fracture of the stable β-phase into many small precipitates located preferentially along grain boundaries and triple junctions. By contrast, HPT processing of the T6 peak-aged specimens revealed a partial dissolution of the needle-shaped nanoprecipitates. The different evolutions of the precipitate distributions following straining in the as-cast and peak-aged conditions gave rise to dramatic differences in the mechanical properties and the operative deformation mechanisms at warm temperatures. These results provide evidence that the high temperature mechanical behavior of age-hardenable Al alloys may be conveniently controlled by altering the precipitate distribution followed by severe straining.

Keywords

Al-Mg-Si alloy; High pressure torsion; Precipitates; Deformation mechanisms; Microstructure