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Effect of mechanism of severe plastic deformation on microstructure and mechanical properties of Al–Li alloy at room temperature

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ABSTRACT

In order to study the effect of mechanism of large plastic deformation at room temperature on microstructure and mechanical properties of Al–Li alloy, Al–Li alloy was processed by high-pressure torsion deformation technology (HPT) ($\varepsilon_{eff} = 1.84–3.9$), and the FEM analysis was employed to simulate the stress–strain field during plastic deformation. The research results have shown that compared to the low plastic deformation ($\varepsilon_{eff} < 1$), the grain size of Al–Li alloy can be refined to the nanometer scale significantly by the large plastic deformation technology. With the equivalent strain increasing, the grain was refined to 128 nm, dislocation density increased to 40.8×10^{14} m^{-2}, precipitates were dissolved into the matrix, microhardness and tensile strength significantly improved, and meanwhile the ductility decreased. Grain boundary and dislocation strengthening were the main strengthening mechanisms of severe plastic deformation at room temperature. The fracture mode of alloy was quasi-cleavage fracture.

KEYWORDS: plastic deformation, microstructure, mechanical properties, Al–Li alloy