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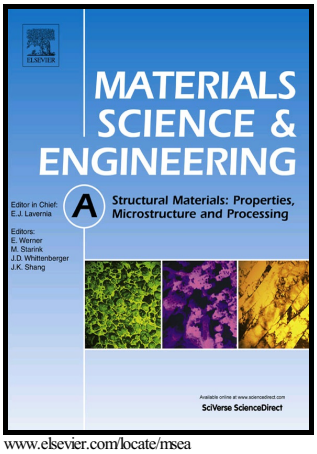

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Annealing effect on microstructure and mechanical properties of Al/Ti/Al laminate sheets

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Abstract

Trimodal composites, consisting of ultrafine grains, coarse grains, and particles, are known to possess desirable combinations of physical and mechanical properties. In this paper, we report the fabrication of a sheet of trimodal material using roll bonding and annealing of an Al/Ti/Al laminate at 873 K for durations ranging from 6h to 168 h. The Al/Ti/Al laminate was roll bonded from 625 μm (Al sheet thickness 300 μm, Ti foil thickness 25 μm) to 130 μm. The Ti layer was seen to break up and disperse in the aluminium matrix after rolling. It was found that when the annealing time was less than 12 h, there were residual voids at the interface between the $TiAl_3$ and Al layers, resulting in reduced ductility and strength of the composite sheet. When the annealing time was increased to 24 h, there were no residual voids and the laminate became a kind of trimodal material, consisting of a combination of coarse-grained Al, ultrafine-grained Ti and $TiAl_3$ particles. This kind of laminate shows the highest yield strength and good ductility. With a further increase in the annealing time to 168 h, no residual pure Ti was seen in the laminate and the $TiAl_3$ particles were found to be distributed in the Al matrix close to the laminate surface, leading to lower strength and ductility. We also discuss the microstructure evolution and the deformation mechanism during tensile testing.