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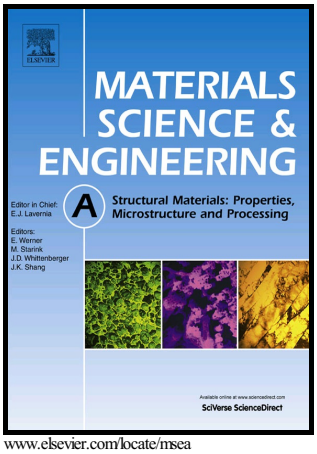

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Abstract

Friction stir welding (FSW) was performed on β-type Ti-15V-3Cr-3Al-3Sn alloy (Ti-15-3, mass%) plates to fabricate a sound weld joint. The microstructural and mechanical properties of the weld joint were systematically investigated in order to understand the response of the β-type titanium alloys to the FSW. The results show that a defect-free Ti-15-3 alloy weld joint can be successfully fabricated by the FSW. In the thermo-mechanically affected zone (TMAZ), the microstructural evolution is predominantly driven by discontinuous dynamic recrystallization because of the low stacking fault energy of the alloy that results in a low dislocation mobility; while in the stir zone (SZ) it is mainly promoted by continuous dynamic recrystallization due to the high temperature and high strain achieved in the SZ which improve the dislocation mobility. The material flow field within the SZ shows an incline of ~10° towards the advancing side (AS) around the welding direction (WD). The base material and the weld-associated zones (TMAZ and SZ) show comparable mechanical properties, which is due to the competitive effects of the dislocation density, grain diameter and grain orientation. This homogeneous mechanical property distribution makes the Ti-15-3 alloy joint preferred for industrial applications.