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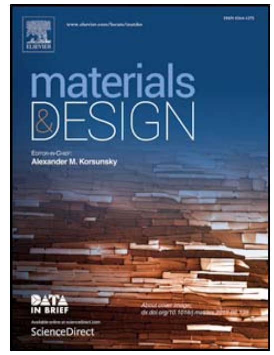

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Abstract

Friction stir spot welding of high-Mn twinning-induced plasticity steel was studied. Welds were made at different tool rotation speeds and constant plunge rate and dwell time. The microstructure evolution was examined by optical microscopy, scanning electron microscopy and electron backscattered diffraction technique. In addition, the microhardness distribution and tensile-shear load bearing capacity were measured. The friction stir spot welding process successfully produced high integrity completely defect-free joints at all the proposed welding parameters. However, the complex plastic deformation and high thermal cycle experienced had a significant effect on the weld region, which consisted of three distinct zones. The flow transition zone, stir zone and torsion zone were all characterized by a recrystallized grain structure. The heat affected zone was characterized by a coarse grain structure as a result of grain growth caused by the high thermal cycles experienced. The hardness was significantly affected by friction stir spot welding, resulting in a softened region in the joint area. The softening increased as the rotation rate increased. The maximum peak tensile shear load of 13 kN was obtained at 750 rpm, and a considerable amount of extension was obtained in all the joints with a maximum of 4 mm at 500 rpm.

Keyword: TWIP, steel, friction stir spot welding, microstructure, EBSD, mechanical properties