

OP 520

Double-sided friction stir spot welding of ultra-high strength C-Mn-Si martensitic steel by adjustable probes

Xiaopei Wang¹, Yoshiaki Morisada², Kohsaku Ushioda², Hidetoshi Fujii²

¹*Tsinghua University, Beijing, China*

²*Osaka University, Osaka, Japan*

High-quality joints of ultra-high strength C-Mn-Si quenched and tempered martensitic steel were successfully fabricated by double-sided friction stir spot welding (FSSW) with adjustable probes. We found that the mechanical properties of the welded joints increased with the rotation speed, due to the increase of hard phase and strengthened welding interface. In the surroundings of the shoulder/probe interface, a large amount of martensite was formed resulting from the higher austenitizing temperature and the higher cooling rate. In addition, severe material flow vertical to the welding interface and strong relative slip along the interface conspicuously favored the fragmentation and dispersion of the oxides, and the drive force for grain boundary migration introduced by severe material flow further promoted the dispersion of the oxides. Consequently, a high-quality welding interface was fabricated, and a high-strength welded joint with a stable plug failure was obtained. Furthermore, we pointed out that soundly welded high strength interface of ultra-high strength steel can be obtained by higher welding temperature and introducing strong material flow vertical to the interface.