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## Microstructure and morphology evolution of probeless friction stir spot welded joints of aluminum alloy

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### Abstract

A third generation Al-Li alloy has been successfully welded by probeless friction stir spot welding (P-FSSW). The joints presented symmetrical 'basin' shapes and two distinct regions were observed: the stir zone (SZ) and the thermo-mechanically affected zone (TMAZ), which were characterized by recrystallized grains and deformed grains, respectively. In order to study the relationship between the P-FSSWed joint morphology and mechanical strength, a phenomenological model of various geometric features of these joints, including the stir zone width, the stir zone edge angle (SEA) and the hook angle (HA), was established. According to the model, the actual stir zone was described by an ellipse which has its limitation, no matter how to change the welding parameters. The tensile/shear strength was related significantly to the morphology of hook defect, and so was the fracture mode. Additionally, a one-to-one correlation existed between shoulder diameter and sheet thickness to achieve a sound weld, which was useful in manufacture to yield high-quality joints.

**Keywords:** Friction stir welding; Microstructure; Fracture mechanism; Structure-property relationship

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