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Numerical design of high depth-to-width ratio friction stir welding

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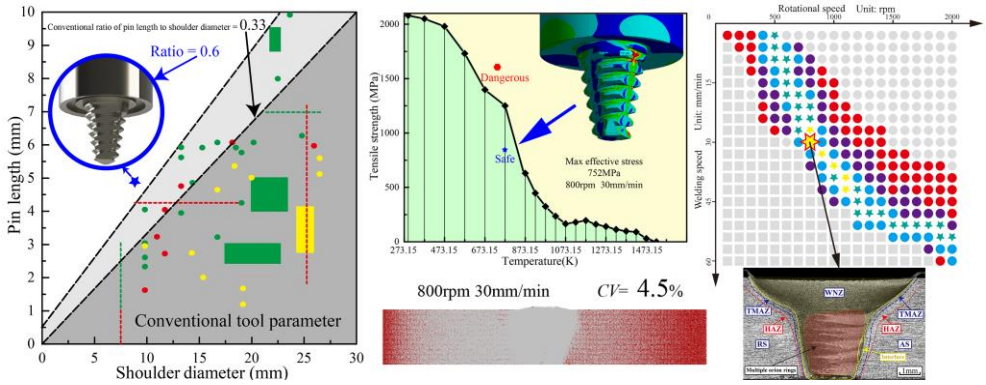
Graphical abstract



Abstract

Tools with a high depth-to-width ratio of 0.6 were designed and tested. The thread structure of pin could promote material flow but increase fracture risk. The pins with milling facets were more beneficial to achieve sound joint. The tapered thread tool with triple facets was the optimal structure for high depth-to-width ratio friction stir welding at a rotational speed of 800 rpm and a welding speed of 30 mm/min. The measured temperature and joint formation agreed with the predicted data well. A narrower average heat affected zone with the width of 440 μm was obtained, which was far lower than that underwater friction stir welding.

Keywords

High depth-to-width ratio; Friction stir welding; Al-Mg-Si alloy; High-throughput