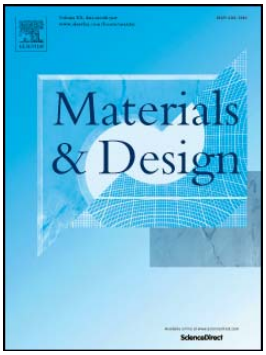

Microstructure-property characteristics of a novel non-weld-thinning friction stir welding process of aluminum alloys

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Abstract: The weld thinning phenomenon occurring in conventional friction stir welding (C-FSW) has negative effects on the formation quality and serviceable reliability of FSW joints. The existing methods for solving the weld thinning problem in FSW exhibit some universal deficiencies, such as low efficiency, low quality and narrow applicable range. Motivated by this challenge, a novel non-weld-thinning (NWT) FSW process, during which a zero shoulder plunge depth is applied to the welding tool, is proposed and investigated in the present paper. The results indicate that the high quality NWT-FSW joints can be efficiently produced by using this novel process. Microstructural analysis implies that the grains in weld nugget of NWT-FSW joints present smaller size and a more uniformly distributed feature than those of C-FSW joints. Compared with the C-FSW joints, the NWT-FSW joints are characterized by narrower softening regions and higher minimum hardness values, leading to an increase in tensile strength during tensile test. The temperature history analysis suggests that the thermal effect of tool shoulder is effectively controlled during NWT-FSW due to the application of zero shoulder plunge depth, which is the intrinsic reason for the grain refinement and strength improvement of NWT-FSW joints.

***Key words*:** Non-weld-thinning friction stir welding; Aluminum alloy; Microstructure characteristic; Mechanical property

1. Introduction

Friction stir welding (FSW) is a solid-state joining method particularly suited for aluminum alloys, which are often difficult to fusion weld without hot cracking,

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