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Influence of Friction stir processing conditions on the manufacturing of Al-Mg-Zn-Cu alloy/boron carbide surface composite.

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Abstract

Surface metal matrix composites were synthesized via friction stir processing (FSP) on the surface of aluminium alloy 7075 (AA 7075) sheets by incorporating B_4C particles (B_4C_P)[1]. The influence of tool rotational speeds, powder particle sizes, and change in tool travel direction between FSP passes on particle distribution and resulting properties were studied in detail. Change in tool travel direction, decreased tool rotation speed and fine B_4C particles enhanced B_4C_P distribution and wear properties thereof. Wear resistance of composites were doubled on account of the B_4C_P distribution and resultant several strengthening mechanisms.

KEYWORDS: Materials processing, metal matrix composite, friction stir processing, aluminium, boron carbide, wear.

1. INTRODUCTION

Solid state, friction stir processing (FSP) technology was principally derived by Mishra et al. (Mishra et al., 2003) from friction stir welding (FSW) technique. In last few years, the technology has evolved as an attractive alternative for surface and subsurface modifications. A schematic of FSP in Fig. 1, elucidates the working principle of the FSP for the synthesis of surface metal matrix composite (SMMC). It comprises of a non-

[1] Abbreviations: B_4C_P, boron carbide powder particles; FSP, friction stir processing; CTTD, change in tool travel direction between passes; SD, same direction between passes; SEM, scanning electron microscope; OM, optical microscopy; XRD, X-ray diffraction; MMC, metal matrix composite; SMMC, surface metal matrix composites; FSW, friction stir welding; FSPed, friction stir processed; SZ, stir zone; TMAZ, thermo-mechanically affected zone; HAZ, heat affected zone; AS, advancing side; RS, retreating side; PM, parent metal; DRX, dynamic recrystallization; T_{peak}, peak temperature; COF, coefficient of friction.

Symbols: ω, tool rotational speed; *v*, tool traverse speed; θ, heat input efficiency; μ, coefficient of friction; P, pressure; R, tool radius;