MICRO-GROOVING OF ALUMINUM-BASED COMPOSITES USING Nd:YAG LASER MACHINING

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Abstract

This paper describes the pulsed Nd:YAG laser machining characteristics on 6351 aluminum reinforced with silicon carbide (SiC) and boron carbide (B_4C) particles. The composites are prepared using stir casting route by varying the weight percentage of B_4C (0, 5, and 10 wt.%). During experimentation, the traverse speed (5, 15, and 30 mm/s) and the laser pulse frequency (5, 9, and 15 kHz) are considered to evaluate the groove width. The results reveal that the lower pulse frequency produced poor groove surface quality. Higher thermal energy dissipation at lower traverse speed may also result in the formation of recast layer and heat-affected zone. This is evident from the microscopic image and the EDS analysis. Thus, the optimum condition (composite with 10 wt.% B_4C machined at 30 mm/s and 15 kHz) to achieve minimum grove width with improved surface morphology is identified by desirability analysis. Additionally, the regression model is developed to predict future values (R^2 at 91.86% and R^2 (adj) at 87.55%). Finally, the probability plot confirms the effectiveness of the proposed model at 95% confidence level.

Keywords: Nd:YAG laser ▪ traverse speed ▪ pulse frequency ▪ groove width ▪ desirability