ENHANCING MICRO FRICTION STIR SPOT WELDING (μFSSW) WELD QUALITY PREDICTION THROUGH FUZZY LOGIC OPTIMIZATION WITH PARTICLE SWARM OPTIMIZATION

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ABSTRACT

Micro Friction Stir Spot Welding (μFSSW) plays a pivotal role in microelectronics and precision manufacturing, demanding a precise understanding of the complex interplay between various parameters for optimal weld quality. This study aims to enhance μFSSW weld quality prediction by integrating advanced optimization techniques. Fuzzy Logic Optimization is employed to model the inherent uncertainties, while Particle Swarm Optimization (PSO) fine-tunes the parameters for improved accuracy. The research assumes a comprehensive framework involving fuzzification, fuzzy inference, and defuzzification steps within a Fuzzy Logic System (FLS). Fuzzy Logic Optimization captures the intricacies of μFSSW by adapting fuzzy sets and rules, providing a nuanced representation of input-output relationships. The collaborative exploration facilitated by PSO optimizes the FLS configuration, aiming to effectively navigate the expansive solution space. Simplifications, such as assuming steady-state conditions and linear input-output relationships, are made to streamline the modeling process. The study focuses on a single-pass welding scenario, allowing for a more in-depth investigation into specific parameters. The research assumes uniform tool wear and neglects specific thermal effects for computational tractability. Results are expected to showcase an optimized FLS model that accurately predicts μFSSW weld quality and exhibits adaptability across varying conditions. The study contributes valuable insights into optimizing micro-scale welding processes, addressing the critical need for high-precision and reliable spot welding techniques in microelectronics and precision manufacturing.

Kata Kunci: *Magnesium alloy, fuzzy logic model, thin material, response surface model*