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The Influence of Power Modulation Laser Welding on the Interface Microstructure and Mechanical Properties of Aluminum-Steel Dissimilar Metal Joints

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The interface between aluminum and steel dissimilar metals is prone to the formation of brittle intermetallic compound layers during the welding process, which significantly affects the mechanical properties of the welded joint. To address this issue, our team has proposed a power modulation laser welding system that can modulate the power and alter the energy distribution on the weld surface, providing a high level of control over the weld pool. In the experiments, aluminum-steel lap joints were welded using both constant power mode (CP) and gradient power mode (GP) to examine the effects of scan frequency and power modulation on the formation of intermetallic compounds at the interface and the joint properties. The results indicate that laser welding with different power modulation modes can control the thermal field distribution at the interface to achieve a more uniform interface layer. By changing the energy distribution on the weld surface of the aluminum-steel joint, it is possible to limit the generation of intermetallic compounds.