The Effect of Peak Power and Pulse Duration for Dissimilar Welding of Brass to Stainless Steel

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A pulsed Nd:YAG laser was used to weld overlap joint between H62 brass and 316L stainless steel in thermal conductivity welding mode. Effects of peak power and pulse duration were investigated under the condition of constant pulse energy. Optical microscopy (OM), scanning electron microscope, and X-ray diffraction were used to analyze the microstructure, defects, and intermetallic phases in the interface, respect- ively. Microhardness test and tensile test were carried out to identify the mechanical property on the welded joints. The results showed that the microstructure, penetration-to-width ratio (*u*), and mechanical properties were affected by the combined effects of peak power and pulse dur- ation when the pulse energy was constant. When the magnitude of the peak power equals to 1846 W, both of penetration-to-width ratio and microhardness in the welded joints stayed to a minimum value. But if the magnitude of the peak power is less than 1846 W, the welded joint has the fewer defects, superior microstructure, and mechanical properties while comparing with the greater peak power.

*Keywords* Brass; Dissimilar; Laser; Mechanical; Property; Stainless; Steel; Welding.

**INTRODUCTION**

In recent years, welded components needed superior performance and stricter operating requirement based on the industrial development and the technological pro- gress. Therefore, only one kind of metal welding has been not suitable for the complex function in engineering applications. The dissimilar material welding, as a prom- ising approach to technology, has been received extensive attention and made amazing progress in the petroleum chemical industry and aerospace ﬁelds [1, 2]. Owing to the advantages of high thermal conductivity, superior mechanical strength, and high corrosion resistance, a welded joint formed between stainless steel and copper alloy was regarded as the most signiﬁcant progress in dissimilar joining applied in the aerospace, machinery, metallurgical, and refrigeration industries.

Currently, there are several dominating welding meth- ods of stainless steel and copper alloy such as ultrasonic welding, friction stir welding, resistance welding, electron beam welding, and laser welding. For the reason of the obvious difference in melting point, thermal conductivity, and coefﬁcient of linear expansion of the two metals, it is therefore difﬁcult to form a welded joint between stainless steel and copper alloy. Hence, achieving the defect-free stainless steel to copper alloy dissimilar joint using the conventional methods mentioned above seems impossible. Electorn beam welding was often used in manufacturing the dissimilar joint due to the high power density heating sources, high speed, and narrow heat-affected zone [3–5]. However, electron beam welding needs vacuum conditions and demagnetization before welding, making it even harder. By comparing with the electron beam welding, the laser welding not only inherits the advantages (high power density heating sources, high speed, and limited heat-affected zone) of electron beam welding, but also uses shielding gas replace vacuum condition to solve the defects of electron beam welding. Hence, laser welding [6–10] is considered as a promising method to join copper-base alloy and stainless steel at present.

In this paper, the inﬂuence of pulse duration and peak power under the condition of constant pulse energy using a Nd:YAG pulsed laser beam were investigated. The objective of this investigation aims at the optimal process parameters on microstructure and mechanical properties in H62 brass to 316L stainless steel welding by Nd:YAG pulsed laser.

**CONCLUSIONS**

The effects of two different series process parameters on H62 brass–316L stainless steel joints produced by pulsed Nd:YAG laser welding have been analyzed. Following are the conclusions obtained from the present study:

1. Peak power and pulse duration both inﬂuence the penetration-to-width ratio and the microhardness on the welded joint under the condition of constant pulse energy. The penetration-to-width ratio has a minimum value when the peak power was 1846 W. Meanwhile, the microhardness value was minimal when the penetration-to-width ratio was minimal.
2. Increasing the peak power will increase the cracks in the interface under the condition of constant pulse energy. However, the cracks will decrease the shear failure force of the joints.
3. A peak power of 1341 W and a pulse duration of

4.5 × 10—3 s are the optimized parameters when the other welding parameters are ﬁxed. Superior penetration-to-width ratio, high quality surface, and superior mechanical properties (microhardness and shear failure force) can be obtained with the optimized parameters.

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