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Microstructural analysis of Nd:YAG laser welding for Inconel alloy

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Abstract

Nd:YAG Laser welding is the widely used in the welding process in which quality of micro welded area for assembly of small components mainly depends on the input parameters are Laser beam power, Welding speed and Frequency. By considering responses are microstructure for pre and post heat treated welding samples of the Inconel 625 alloy material. These work we are mainly focused on the microstructural analysis for before and post heated for welding samples, after post heat treatment of welding samples the welding area, parent metal and Heat affected zone are Slightly changes occurs on the microstructures of welded area and Heat affected zone for before post heat treatment of welding samples.

Introduction

Nd:YAG Laser welding is one of advanced welding technology. The welding of sheet metal in Nd:YAG laser to achieve Accuracy and high quality welding. But welding area and edges are

damages are occur and HAZ. Although, Heat affected zone is usually affected with laser beam power and welding speed, frequency and laser beam power are utilized to melting of parent material [1]. The HAZ of the material depends mainly on different laser power and Welding speed [2]. Further the process of Nd:YAG Laser welding with continuous and pulsed modes was examined with some researcher and their results revealed that pulsed mode generated good welding quality with moderate power. And continuous mode encourages the high welding speed [3].

The lower welding speed improves the welding quality during Nd:YAG Laser welding In that view many researchers were employed to develop mathematical models for predicting accurate experimental values [4], [5]. Nd:YAG Laser welding process consumes very high cost for carrying out the production. In response the DOE concepts was utilized by some of the researchers to reduce the experimental run [6], [7].

In this work the mainly focused on the microstructural analysis for before and post heated for welding samples are considered as dependent variables and the independent variables are Laser Beam Power, Welding speed and F. Frequency he influences of Nd:YAG Laser welding parameters on dependent variables are identified with the aid of ANOVA table [8]. The dependent and independent variables interaction and their relations are to study of microstructural analysis for pre and post heat treated welding samples and to measure the grain structures [9].

Section snippets

Experimental procedure

The experiments are carried by ABB make Nd:YAG Laser Welding machine as shown in Fig. 1 and the specification of machine as shown in Table 1. The work piece considered for this work is Inconel 625 Alloys 1.2 mm thickness sheet are used as Fig. 2. The input parameters considered are Laser beam power, welding speed and frequency. Three levels of each factor are considered. For reducing the experimental trial runs and cost associated for conducting the experiments the Box-Behnken Design was used

Pre heat treatment of microstructure analysis for welding samples

In that microstructure are measured by optical microscope at 100× magnification factor at the Aqua regia solution are used for etchant solution. The Fig. 3a shows the parent metal Inconel 625 alloy with uniform equi-axed grains. The Inconel 625 alloy is cold rolled and the

grains are oriented along the direction of rolling. The microstructure also shows some alloy carbide precipitates as dark grains at the boundaries.

The Fig. 3b shows the interface zone of the parent metal at the right side and

Conclusion

The main objective for this work to the microstructural analysis for before and post heated for welding samples in Inconel 625 alloy sheets. The following conclusion are made

- The micro structural analysis for Pre and Post heatreatment of Nd:YAG pulsed Wave mode welding samples are used in this work
- The Nd:YAG pulsed Wave mode welding considering parameters are laser power, welding speed and Frequency.
- In microstructural analysis for pre heatreatment of welding samples are parent metal at the

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> *Citation Excerpt :*
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> …They also compared their results with a numerical simulation, showing that there was a good match between the data. Srikanth et al. [20,21] also studied the microstructure and parameters of Nd: YAG laser welding on Inconel 625 superalloy. The results show that when applying laser welding, the use of heat treatment on the workpiece could influence the microstructure.…

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> …Due to the presence of MoS2 the matrix material become ductile and maximum elongationoccurs.The improvement in tensile strengths of AHMMCs is attributable to the materials' reinforcing effect at strain differences, improved interfacial interaction, grain size, and lateral load mechanisms between both the and reinforcement particles [35]. The presence of Tungsten Carbide in the aluminium matrix acts as a location for deposition, and the crystallisation of exiting particles causes the aluminium matrix to recrystallize [36–39]. Fig. 5 shows the different composition of developed aluminium composites, Fig. 5a have the composition of 95 %AL6262 –2%MoS2.…

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> ...The welding speed is proportional to the power supplied which is also correlated to the depth and structure of the work material. Pulsed Nd: YAG welding process would be a neodymium-doped yttrium aluminium grenade (Nd: YAG) laser that is a direct drive laser, Nd: YAG laser that works in both emitted and steady sequence [3,4]. The Nd: YAG laser is now a widely used method of solid-state laser in several sectors at modern era due to its strong thermophysical behavior and fast restoration [5]....

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