Influence of welding speed on the melting efficiency of Nd:YAG laser welding

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ABSTRACT

Melting efficiency is one of the more important measurable parameters in laser welding when assessing the performance of a process. This paper aims to study the effects of speed on the melting efficiency and energy transfer efficiency of Nd:YAG laser welding process. The weld bead on a 304L austenitic stainless steel sheet is created by varying the welding speed. The weld samples are cut in the transverse direction by using electric discharge machining, and the cross-section is prepared for metallographic inspection. The cross-sectional dimensions and beads length are measured by using an optical microscope and image analyzer. A methodology is proposed for estimating the weld pool volume from experimental data and a generalised equation for predicting the melting efficiency and energy transfer efficiency is developed. The results obtained by the proposed method have reasonably good agreement with the models proposed by various researchers. The outcome of the result shows the significant influence of welding speed on melting efficiency and energy transfer efficiency in welding of austenitic stainless steel thin sheets. It will be seen from results that one can select appropriate welding speed and processing conditions to obtain desired melting efficiency.

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Vpliv hitrosti varjenja na talilni učinek pri varjenju z laserjem Nd:YAG

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POVZETEK

Talilni učinek je z vidika vrednotenja učinkovitosti postopka eden izmed najbolj pomembnih merljivih parametrov pri varjenju z laserjem. Namen pričujočega članka je proučiti vpliv hitrosti varjenja na talilni učinek in izkoristek prenosa energije pri varjenju z laserjem Nd:YAG. Varek je bil narejen na avstenitnem nerjavnem jeklu 304L, in sicer s spreminjanjem hitrosti varjenja. Vzorci so bili nato prerežani v prečni smeri z uporabo postopka elektroerozije, preseki pa so bili pripravljeni za metalografski preizkus. Z optičnim mikroskopom in analizatorjem slik so bile izmerjene dimenzije preseka in dolžine varkov. V članku je predlagana metodologija za oceno volumna taline zvara iz eksperimentalnih podatkov, prav tako pa sta podani splošni enačbi za napovedovanje talilnega učinka in izkoristka prenosa energije. Dobljeni rezultati se precej dobro ujemajo z modeli, ki so jih predlagali drugi raziskovalci. Rezultati so pokazali signifikantni vpliv hitrosti varjenja na talilni učinek in izkoristek prenosa toplote pri varjenju tanke pločevine iz avstenitnega nerjavnega jekla. Rezultati omogočajo tudi izbiro ustrezne hitrosti varjenja in procesnih pogojev za doseganje želenega talilnega učinka.

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PODATKI O ČLANKU

Ključne besede:

Nd:YAG lasersko varjenje
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Izkoristek prenosa energije
Temperaturno vplivna cona

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