

Guided Gas Tungsten Arc Welding Process

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INTRODUCTION

Gas tungsten arc welding is typically used for critical and accurate joining in manufacturing because of its capability in precision control of the welding fusion process. However, it is not easy to be used for ultra-thin plate due to the low amperage. To this end, a modified GTAW, referred to as guided gas tungsten arc welding process, is developed to improve the controllability of the arc concentration and directionality. The improved arc concentration and directionality may help improve the accuracy of arc voltage based arc length measurements.

PROCEDURE

To improve the arc concentration and directionality, a hollow tungsten is used as the electrode. Non-transfer plasma jet is directed through the hole of the hollow tungsten toward the workpiece and forms an electrical passage “attracting” or “guiding” the electrons emitted from the electrode. The arc thus becomes concentrated and stiff despite the low amperage. In this study, the diameter of the hole of the hollow tungsten is around 1 mm (0.04 in.) for plates 0.75 mm (0.03 in.) or thinner.

RESULTS AND DISCUSSION

To verify the feasibility of the proposed process, experiments have been conducted using different thickness and speeds to make bead-on-plate and butt joint on stainless steel 304. Regular GTAW is used for comparison. It is found that the welds made using regular GTAW are typically 2 to 3 times, on the front-face, as wide as those made using of the proposed process in order to form

full penetration. When the speed is 4 mm/s (9.5 in./min), the proposed process achieves full penetration on 0.64 mm (0.024") thick plate using 13 A average current, but the arc voltage is around 25 V.

Analysis suggests that part of the heat generated by the arc dissipates through the hollow tungsten. The use of the hollow tungsten reduces the efficiency of the heat input into the plate while the energy density is improved. Further study is needed to evaluate the reduction in the heat efficiency and the reduction of the needed heat due to the better arc concentration.

CONCLUSIONS

Guided tungsten arc welding is proposed for the welding of thin plates. To verify the proposed process, various experiments have been done in comparison with regular GTAW. Experimental results suggest that the proposed process is capable of improving energy density and suitable for joining of thin and ultra-thin plates.

ACKNOWLEDGEMENT

This work is funded by the National Science Foundation under grant DMI-0114982.