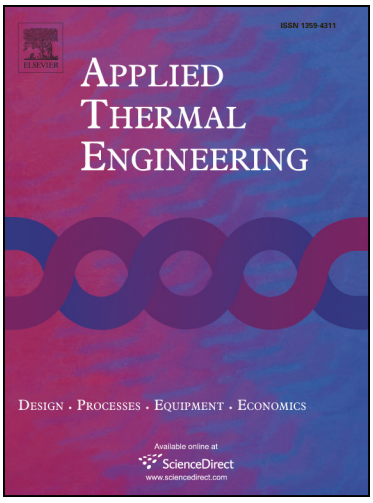
Accepted Manuscript



Finite element analysis and experimental validation of thermal behavior for thin-walled parts in GMAW-based additive manufacturing with various substrate preheating temperatures

Jun Xiong, Yangyang Lei, Rong Li

PII: S1359-4311(17)31341-8
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.07.168
Reference: ATE 10836

To appear in: *Applied Thermal Engineering*

Received Date: 28 February 2017
Revised Date: 21 July 2017
Accepted Date: 21 July 2017

Please cite this article as: J. Xiong, Y. Lei, R. Li, Finite element analysis and experimental validation of thermal behavior for thin-walled parts in GMAW-based additive manufacturing with various substrate preheating temperatures, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.07.168

Finite element analysis and experimental validation of thermal behavior for thin-walled parts in GMAW-based additive manufacturing with various substrate preheating temperatures

Jun Xiong*, Yangyang Lei, Rong Li

Key Laboratory of Advanced Technologies of Materials, Ministry of Education, School of Materials Science and Engineering, Southwest Jiaotong University, Chengdu 610031, China

Postal address: Key Laboratory of Advanced Technologies of Materials, Ministry of Education, School of Materials Science and Engineering, Southwest Jiaotong University, 111, Section 1 North Second Ring Road, Chengdu 610031, China.

*Corresponding author: Jun Xiong

Tel: +86 28 87600726; fax: +86 28 87600726.

E-mail address: xiongjun@home.swjtu.edu.cn

Abstract: Reducing thermal stress and preventing cracking of fabricated parts have been key issues in wire and arc additive manufacturing (WAAM). It is believed that complex thermal behavior in WAAM is a significant cause for thermal stress and cracking of components. Substrate preheating is an efficient approach to treat these issues. A 3D transient heat transfer model of a circular ten-layer single-pass part was built to investigate the thermal behavior in gas metal arc welding (GMAW) based additive manufacturing. Meanwhile, the validation experiment was carried out to check the effectiveness of the finite element model through thermal cycle tests. The simulated thermal cycle curves matched the experimental results well. The effect of substrate preheating on thermal behavior was studied by the verified model. The modeling results show that substrate preheating can make the thermal cycles much smoother and decrease the cooling rate of the molten pool. The maximum temperature gradient in the molten pool decreases with the increasing substrate preheating temperature. At the deposition ending