### Accepted Manuscript

Title: Multi-sensor investigations of optical emissions and their relations to directed energy deposition processes and quality

Authors: Christopher B. Stutzman, Abdalla R. Nassar, Edward W. Reutzel

 PII:
 S2214-8604(18)30023-X

 DOI:
 https://doi.org/10.1016/j.addma.2018.03.017

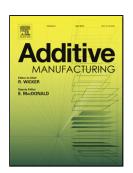
 Reference:
 ADDMA 313

To appear in:

Received date:	16-1-2018
Revised date:	13-3-2018
Accepted date:	14-3-2018

Please cite this article as: Christopher B.Stutzman, Abdalla R.Nassar, Edward W.Reutzel, Multi-sensor investigations of optical emissions and their relations to directed energy deposition processes and quality (2010), https://doi.org/10.1016/j.addma.2018.03.017

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



### ACCEPTED MANUSCRIPT

# Multi-sensor investigations of optical emissions and their relations to directed energy deposition processes and quality

Christopher B. Stutzman (<u>cbs5520@psu.edu</u>) <sup>1</sup>, Abdalla R. Nassar (<u>arn5000@psu.edu</u>) <sup>2</sup>, Edward W. Reutzel (<u>ewr101@psu.edu</u>) <sup>2</sup>

<sup>1</sup> Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park,

Pennsylvania 16802

<sup>2</sup> Applied Research Laboratory, The Pennsylvania State University, University Park,

Pennsylvania 16802

Corresponding Author: Abdalla Nassar

The Pennsylvania State University

Applied Research Laboratory

Abdalla Nassar 4420M

P.O. Box 30

State College, PA 16804-0030

#### Abstract:

Optical Emissions Spectroscopy and plume imaging were utilized to investigate flaws generated during directed energy deposition additive manufacturing. Ti-6Al-4V coupons were built using varying laser power, powder flow rate, and hatching pattern to induce random and systematic flaws. X-Ray Computed Tomography (CT) scans were completed on each part to determine flaw density and flaw locations. Three quantifiable metrics based on the state of the plume during processing are developed, analyzed and compared to the post-build CT scans: (1) line-to-continuum ratio around 430 nm, (2) line-to-continuum ratio around 520 nm, and (3) total plume area. For coupons built with constant laser power, variations in either powder flow rate or hatch pattern that led to an increase in flaw density were accompanied by an increase in median line-to-continuum ratios around 430 and 520 nm and in total plume area. It is also shown that all three metrics appear to measure the same phenomena, i.e. they are internally consistent with each other. These results present a path forward for real-time flaw detection and assessment of build quality in directed energy deposition and powder bed fusion processes.

Keywords: Directed Energy Deposition, Metal Additive Manufacturing, Optical Emission Spectroscopy, Flaw Detection Download English Version:

## https://daneshyari.com/en/article/7205892

Download Persian Version:

https://daneshyari.com/article/7205892

Daneshyari.com