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Abstract

Process Parametrization for the Additive Manufacturing of Metals Using Plasma Direct Energy Deposition (pDED)—Preliminary Study †

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Additive manufacturing (AM) has been an object of intense research and development over the recent years. With the increasing pressure imposed on industries, the development of new processes capable of overcoming the current needs both topologically and geometrically, namely the production of optimized components, has extensively been required [1]. Although metal additive manufacturing (MAM) processes, such as Selective Laser Melting (SLM), are already used in many industrial applications, these processes represent a bottleneck in most industries in terms of productivity due to its high production time. To overcome this problem, processes with higher deposition rates become more attractive for these industries. Direct Energy Deposition (DED) represents a viable and promising alternative for MAM when large components are required to be manufactured. However, the optimal parametrization of DED processes is still a challenge to overcome as it is material and component dependent. Additionally, exact knowledge of the interrelationships between the process parameters and the component geometry is unknown most of the times [2].

This paper focuses on a preliminary parametrization of a plasma DED (pDED) process using a NiCrFeAl alloy to understand the combined effects of current, travel speed, and feed rate on the on the bead geometry. Process parametrization was investigated according to the specifications of a Design of Experiments (DOE) by means of a full-factorial experimental design, resulting in a test matrix of 72 parameter combinations. Results have shown that similar bead geometries can be obtained using different parameter settings. This finding can be useful to lower production times or to optimize the surface finish of the manufactured component. A preliminary, but still comprehensive, knowledge of the relationships between process parameters in pDED was achieved, forming the foundation basis for future developments in this field.

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