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Development of Laser-Arc Hybrid Directed Energy Deposition Process for Ultra-Thin Structure

In Soo Jo

Chanwon National University, Changwon-si, South Korea

PBF (Powder Bed Fusion) or LMD (Laser Metal Deposition) methods, which utilize laser or electron beam sources, are primarily focused on the development of small parts. These methods are advantageous for creating complex shapes due to their high geometric precision. However, they come with disadvantages such as low deposition rates and significant material waste. High deposition rates can be achieved using an arc heat source, though at a cost to geometric precision. This study introduces a process that integrates a laser with Wire arc-directed energy deposition (DED) to fabricate micro-meter-sized ultra-thin structures. Experiments were conducted using a low heat input mode, Cold Metal Transfer (CMT), and an Nd:YAG laser. A wire with a diameter of 0.8mm served as the material, with the laser beam's focus aligned at the point where the wire shorted with the base material. Single metal beads were deposited with widths of less than 950 μm and heights of 850 μm . The porosity, tensile strength, and deposition rate of the fabricated ultra-thin walls were analyzed.

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