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Investigation of the laser-powder-atmosphere interaction zone during the selective laser melting process

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Abstract

Selective Laser Melting (SLM) consists in manufacturing parts in a chamber filled with a protective gas, by melting successive thin powder layers using a laser. This study aims, at first, to understand the laser–material–atmosphere interactions that involve various complex and simultaneous physical phenomena such as heat transfer in the target, melting and vaporization of the material, and expansion of the generated vapor. A modelling approach of the process was developed to investigate the effect of some process parameters, such as the exposure time (t_{expo}) of the laser beam on each point along its trajectory, the pressure of the protective gas (Argon) and the spatial thermal energy distribution on the dimensional characteristics of the melted track.

Keywords: Laser melting process, Rapid prototyping, Additive manufacturing, Numerical modelling, CFD model, Metallic vapour.

1. Introduction

Additive manufacturing processes, also known as rapid manufacturing or rapid prototyping (Edson et al., 2006) allow manufacturing complex shape parts directly from 3D CAD data. Among those processes, Selective Laser Melting (SLM) was developed