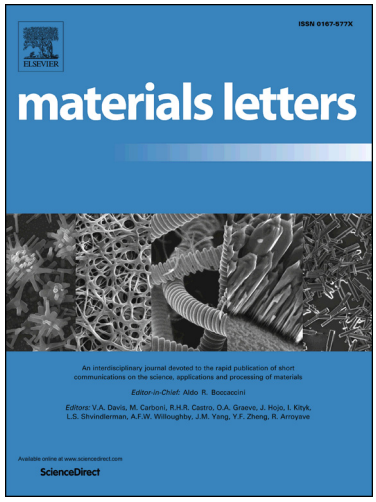

Phase evolution of a heat-treatable aluminum alloy during laser additive manufacturing

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Phase evolution of a heat-treatable aluminum alloy during laser additive manufacturing

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Abstract: Highly-dense Al-5Si-1Cu-Mg alloy bulk was firstly produced by laser additive manufacture (LAM) technique. LAM involves extraordinary thermal cycles and will therefore significantly affect the microstructure. In this research, the phase evolution of LAMed Al-5Si-1Cu-Mg alloy was studied in detail by characterization along the deposition direction. The rapid solidification of LAM encourages the generation of various unstable phases of vermicular Si, fishbone shaped θ-Al_2Cu, blocky π-$Al_8Mg_3FeSi_6$ and irregular Q-$Al_5Mg_8Cu_2Si_6$. As the increasing times of thermal cycling, phase evolution takes place by spheroidization of Si phases, transformation of π-Fe to plate-like β-Al_5FeSi with dissolution of θ and Q phases. In particular, after certain times of thermal excursions, many micron-sized and nano-sized Q′ phases precipitate out from matrix, and the stabilized microstructure consists of α-Al, Q′, Si and β.

Keywords: laser additive manufacturing; metals and alloys; phase transformation

1. Introduction

The improvement of fuel efficiency for aerospace and automobile industries requires weight reduction as far as possible. Aluminum alloys are of great interests due to low density, high specific strength and excellent corrosion properties.[1]Laser additive manufacture (LAM) can be used to build fully dense and near-net-shaped metal components from CAD models by fusing and consolidating powders layer by layer, which provides the availability to build geometrically complex high-performance components with less time and lower cost.[2, 3]Utilization of LAM to fabricate aluminum alloy