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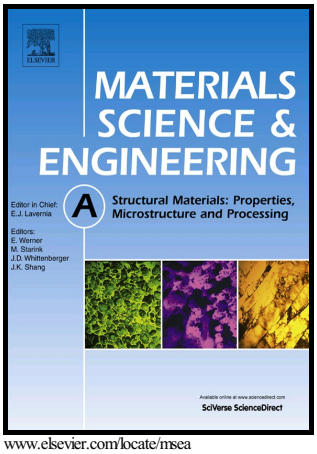

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Influence mechanism of parameters process and mechanical properties evolution mechanism of maraging steel 300 by selective laser melting

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Abstract:

Selective laser melting (SLM) is one kind of additive manufacturing process to fabricate metal parts through laser melting. A maraging steel 300 was manufactured by SLM. And the influence of process parameters (laser powder, scanning speed and scanning space) on the relative density of maraging steel 300 was investigated first. Then a series of block and plate specimens were manufactured. Some specimens were taken as control groups, and others underwent heat treatment by solution treatment (ST) and solution treatment +aging treatment (ST+AT) respectively. The investigation involved microstructure, microhardness, tensile strength and impact toughness. It is shown that: low or high laser power, scanning speed or scanning space all reduced the relative density, and the optimized process parameters could be obtained by orthogonal experiment. After ST, the cellular structure and microscopic segregation disappeared, and the new smaller particles precipitated out after AT. The Ni, Mo and Ti dissolved in the matrix during ST separated out again forming tiny Ni_3Mo, Fe_2Mo and Ni_3Ti particles during AT. The microhardness and tensile strength dropped a little with elongation increasing after ST. While they increased significantly with elongation decreasing after AT. The impact toughness increased little after ST, but decreased sharply after AT.

Key words： Selective Laser Melting; Maraging steel 300; Relative density; Microstructure; Tensile strengthen; Impact toughness

1. Introduction

Selective laser melting (SLM) is one kind of additive manufacturing technologies, which makes it possible to manufacture metal components layer by layer according to a 3D-CAD volume model [1]. The laser beam is controlled by industrial computer to melt metal powder. The melting tracks are obtained by moving the laser beam, and the layers are formed by joining the melting tracks. This technology overcomes the design limitations of traditional methods and avoids complex manufacturing process. The manufacturing cycle time of products can be shorten, and the parts with complex geometry can be manufactured rapidly. Compared to the conventional manufacturing methods, finer structures can be observed in the microstructure at very high cooling rate [2]. Excellent mechanical properties can be obtained. Therefore, SLM is widely used in aerospace, automobile, medical treatment and industry applications [3-5]. However, some of the parts directly manufactured by SLM cannot meet the requirements, so it is necessary to make heat treatment for more excellent comprehensive performance.

The 18Ni-300 maraging steel is one kind of ultra-high strength steel, especially after ST+AT, which is widely used in the fields of aircraft, aerospace, tooling and molds. The reason for high strength of the 18Ni-300 maraging steel is that the intermetallic precipitates can be formed during

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