Research of Specific Heat Treatment for AlSi7Mg0.6 Alloy Manufactured by Laser Beam Melting

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ABSTRACT

In the last few years, the use of the LBM process is rapidly increasing, especially for the manufacturing of metal parts. Aluminium alloys are strong candidates to develop this technology. Its low density, combined with design optimization made possible by additive manufacturing, provides the opportunity to reduce structure weight, which is a central development axis for the aerospace industries. Aluminium alloys, including cast AlSi7Mg0.6, are currently under studies as material properties after LBM manufacturing do not reach high enough levels to be implemented directly for structural applications even after commonly used T6-type heat treatment. In order to reach higher materials properties, new heat treatments need to be developed taking into account the specific microstructure formed during LBM process.

This study aims at developing new heat treatments strategies to improve mechanical properties of AlSi7Mg0.6 parts manufactured by LBM. Hardness measurements and tensile tests have been performed following heat treatments as well as density measurements and multi-scale microstructure analysis. Specific heat treatments developed in this study allow either reaching equivalent tensile properties as those of cast AlSi7Mg0.6 alloy or values close to properties of wrought Al-alloys with limited ductility.

INTRODUCTION

The Laser Beam Melting (LBM) technology is an additive manufacturing process that enables the production of parts with complex geometries. Thus, it is of great interest for many industrial sectors (automotive, medical, aeronautics, space…) as it may offer new design opportunities, function integration to finally allow a significant reduction of mass. The process by fusion of material induces many physical phenomena related in particular to laser/material interactions, contaminations, evolutions of chemical composition or transfer of alloying elements during the process. Nowadays, a wide range of metallic materials are studied by LBM, like titanium[1-2], nickel[3], iron[4-5] or aluminium based alloys[6-8].

In the framework of AnDDurO project, studies have been led on the development of post-manufacturing heat treatments optimize and improve physical and mechanical properties of materials and components. Indeed, up to now, heat treatment specifications are strongly inherited from cast part heat treatment