Abstract

Additive Manufacturing of metal alloy for aerospace by means of Powder Laser Cladding: station tuning and clad characterization

This thesis investigates the application of continuous coaxial laser cladding by powder injection as repair and cover process. The investigation aimed to check the possibility of repairing a V-groove geometry on a substrate of AA2024 and A357 aluminum alloy.

Chapter one is an introduction to the laser cladding. This presents a general overview of the laser cladding methods and some applications for the processes.

In the second chapter, the laser cladding process is analysed in terms of process parameters and responses. First of all a basic description of the process is presented with a classification of the technology: laser cladding technology could be carried out in one step and two steps. The feeding deposited material could be powders, wire or paste.

Chapter three provides a comprehensive comparison of available lasers, powder feeders, and nozzles to demonstrate their potential and suitability for use in laser cladding technology. It is very important to know the field of application of the different configurations, which depend on the particular condition and use.

In chapter four details of the laser cladding station and of the experimental setup used in this research are presented. The last section of this chapter describes the process tuning.

In chapter five, the experimental tests and the final analyzes for each experimentation are discussed.

The first one is a test of single deposition on a AA2024 aluminum alloy plate carried out in order to understand the alloy characteristics for this process and to analyze the most important responses of the laser cladding process. The effect of the most significant parameters is analysed in terms of main effect and interaction plots by Minitab statistic software.

The second one is a about a filling milled grooves through laser cladding for repair applications. In particular a pre-machined V-grooves on AA 2024 aluminum plates has been repaired by the laser cladding process with AA 2024 aluminum powders alloy.

In order to analyse the process for another aluminum alloy, the same groove has been milled and filled on A357 aluminum alloy plates. This alloy exhibits a relatively high flowability, which is preferred for Additive Manufacturing processes. It is a precipitation-hardenable A357 alloy, so an analysis pre and post heat treatment is carried out.

In conclusion a model to analyse the laser cladding cost is shown.