Segregation network structure investigation on 316L stainless steel processed by Laser Cladding

Tommaso MAURIZI ENRICI[1,a], Jérôme Tchoufang TCHUINDJANG[1,b], Anne MERTENS[1,c]

1 : Metallic Materials Science (MMS) – Aerospace & Mechanical Engineering Department; Bâtiment B52 (Sart Tilman); Allée de la Découverte 13 – 4000 Liège (Belgium)

[a]tommaso.maurizi-enrici@uliege.be - [b]j.tchuindjang@uliege.be - [c]anne.mertens@uliege.be

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INTRODUCTION

Additive manufacturing (AM) techniques are promising net-shape manufacturing technologies, producing complex 3D solid parts from powders according to computer-aided design (CAD) models. The one-step building process, the versatility, fast process speed and simplified post-treatment make AM a realistic candidate for fabrication of various components. One important member among the AM technologies is Laser Cladding (LC). The hierarchical new microstructures, different from the conventional ones, and the peculiar segregations caused by this technique have attracted the attention of both academic and industrial world [1]–[3]. In that respect, the structures formed on the common stainless steel (SS) 316L due to its combination of good mechanical properties at high temperatures, good machinability and excellent corrosion resistance appear particularly interesting.

Indeed, this work considers a SS316L laser clad deposit produced using a parallel deposition strategy. Microstructural characterization reveals the classical hierarchical macro-, micro- and nano-structures in as-built samples. The extremely high cooling rates lead to specific segregations for each hierarchical structure scale, leading potentially to complex phase formations and enhanced mechanical properties due to improved strengthening mechanisms.

Nano-indentations grids, macro-hardness tests and Electron Back Scattered Diffraction (EBSD) observations were carried out in order to evaluate the mechanical properties at different scales, both inside melt pools and in heat affected zones (HAZ). A particular attention was given on the impact that every hierarchical structure may have on the macro-properties at different positions inside the deposits, in order to obtain new insights and to tailor their properties following a bottom-up approach.

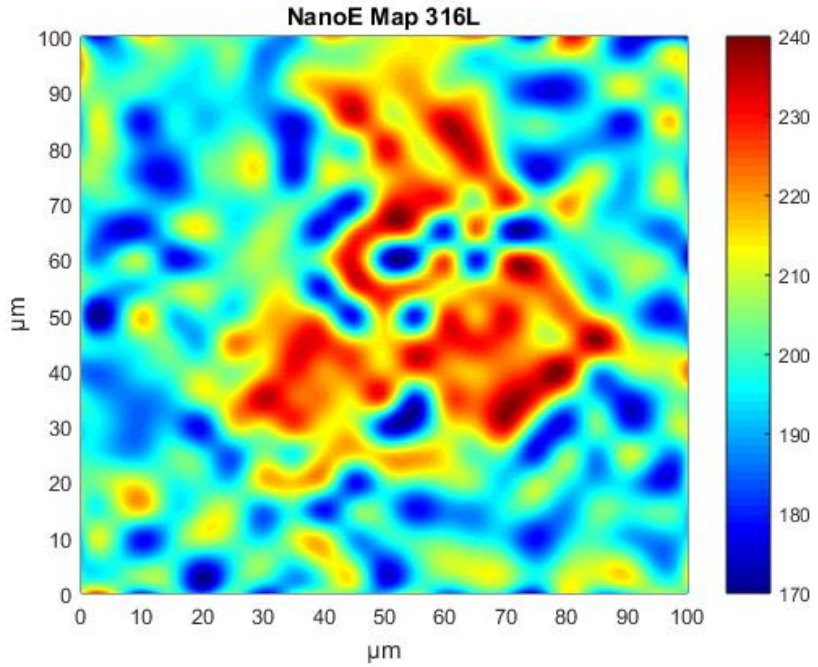

Figure 1 : Example of a Nano-indentation grid on a SS 316L specimen. The indentations were carried out in displacement control mode (300nm) with a inter-distance of 5 µm.

References

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