Satalliting of WC-Co Composite Powder for Additive Manufacturing

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Abstract

Tungsten carbide-cobalt (WC-Co) system has been widely employed as an abrasion/wear resistant material because of its unique combination of high hardness and toughness. The conventional powder-metallurgical manufacturing of this system is expensive, time consuming, and has considerable design restrictions. The integration of complex geometrical products such as an internal structure, optimized cooling channel system or chip flute topology cannot be performed using conventional methods.

Laser-based additive manufacturing, such as direct energy deposition (DED) and selective laser melting (SLM), is an advanced material processing technology which has the ability to produce different materials regardless to their geometrical complexities. However, undesired features such as cracks, porosity, decarburization or dissolving of ceramic particles, and non-uniform microstructure have been detected in the laser processed parts. The variances in microstructure could lead to variances in microhardness values through the sample material which are extremely considered unfavourable for the manufacturing of cutting tools.

In this study, an innovative powder preparation method 'Satelliting' is used. The expected impact of the satelliting method on material microstructure is owing to its ability to produce homogenous composite powder through producing a uniform distribution of WC particles in the Co metal matrix. Successful single clads have been obtained by using satelliting WC-12wt.%Co feedstock within DED processing. The results showed that, the satellited clads have no porosity, no cracks, and no dissolving of the WC particles features. Work is ongoing to find out a suitable balance between WC and Co phases in order for the best material microstructure. The satellited powder presents a better behaviour for all deposited clads with respect to the shape uniformity and microstructural characteristics in comparison with the blended feedstock. The SLM preliminary samples showed a very tough materials, however a clear evidence of cracks is observed and more optimization of the process parameters is ongoing.