X-RAY IMAGING OF ADDITIVE MANUFACTURED DRILL AND GEAR WHEEL

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Keywords: X-ray Microscopy, Computer Tomography, Additive Manufacturing, EBSD

Summary: In this study we will show the suitability of computer tomography and microscopic methods for evaluating the quality additively manufactured indexable insert drills with curved cooling channels.

1. INTRODUCTION

The layer by layer build-up process of 3D printing is a new and promising method for the production of components in engineering. Especially the high geometric and constructive freedom, so the creation of complex geometries and integrated functional properties, such as curved cooling channels in drills is of big interest.
To bring additive manufacturing to the next stage from prototype production to serial production, materials researcher evaluate various properties e.g. microstructural defects that can significantly degrade the usage properties of components, the dimensional accuracy and the surface quality.

2. EXPERIMENTAL METHOD

The experiments were performed on steel powder and AlSi10, conventionally produced indexable insert drills with later machined cooling channels as well as additively manufactured ones with curved cooling channels. In addition polished sections of SLM (selective laser melting) produced materials were evaluated.
The used analysis equipment are light- , electron- , X-ray microscopy and CT.

3. RESULTS

The study outlined the suitability of microscopic methods for the evaluation of additively manufactured indexable insert drills with curved cooling channels. Since the occurring microstructure of the components depend particularly on the powder characteristics, light and electron microscopy were in a first step utilized to observe the particle size distribution and morphology of the used steel powder. The steel powder in Figure shows a monomodal particle size distribution, AlSi10 in contrast is distributed bimodally. Agglomerations and the roundness of the particles, which is necessary for a well flowing powder in the process, was also detected. CT measurements then revealed the inner structure of the indexable insert drills and allowed a verification of dimensions from the CAD drawing. Finally light microscopy was able to check process condition dependencies. The results showed a clear microstructural evolution in response to the linear energy density (LED). Porosity and pore size decreased with increasing linear energy density (LED).

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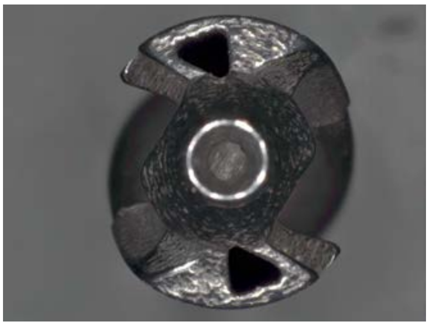

Figure 1: Tip of an additively manufactured cutting insert;
ZEISS Smartzoom 5, 20×, ringlight, HDR