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Influence of process parameters on microstructure and residual stress in alloys produced by additive manufacturing.

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Metal Additive manufacturing (AM) allows printing structures of almost any complexity.
Therefore, it is an uprising technique in various industrial sectors like automotive and aerospace. Nevertheless, in the manufacturing method of laser powder bed fusion (LPBF) the used process parameters have a high influence on the final part. They impact texture, residual stress and also the tensile properties. To achieve consistent material characteristics, a pro-found understanding of the process parameter influence is needed.

In the current presentation, we investigate the evolution of residual stress, texture and the tensile properties of additively manufactured samples as a function of build direction and diameter. Two different alloys, 316L and AlSi11Mg0.5, are used as sample material. They are both widely utilized in AM and form a fcc structure. But 316L has only one phase and is highly anisotropic, whereas AlSi11Mg0.5 is a nearly isotropic two-phase metal.
This study uses high energy synchrotron X-rays to assess the residual stress and the texture of the different samples. Furthermore, in-situ tensile tests were conducted to study the elastoplastic behaviour and the dislocation densities. The results are evaluated with respect to the different process parameters. In addition, a comparison between the two alloys is conducted to determine how much the material-specific properties affect the finished component.

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