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ABSTRACT:

Shaping of Material Properties through Additive Manufacturing – Gaussian Beam Profile versus Beam Shaping

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Single-step additive manufacturing (AM) processes are known to allow amongst the highest range in modifications of the microstructure possible. These include modifications in chemical composition, relative density, texture, phases and phase distribution. Thereby providing an unprecedented access to the material properties and their deliberate alteration. With the onset of direct access to the energy distribution profile over the irradiated area, the options to influence the microstructure widens further. The presented work encompasses the current state of the art on the alteration of the microstructure, and with it its mechanical properties, through beam shaping. Recent investigations showed the possible shift from the common <100> texture in 1.4404 (316L) stainless steel achieved through Gaussian beam profiles to a <111> texture by utilization of a ring shaped beam profile. Going from one microstructure to the other, however, is not sudden, it requires about 30 layers to transition from one to the other.

References

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Grünewald, J., R. Pfund, D. Röhrer, L. Hitzler, J. Torgersen and K. Wudy (2025). "Tailored microstructures in laser-based powder bed fusion of 316L using beam shaping: From microstructure formation in individual specimens to their transition in segmented parts." Additive Manufacturing 113.