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Comparison of Selective Laser Melting Post-Processes based on Amplitude and Functional Surface Roughness parameters

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Metal Additive Manufacturing - Post-Processing - Surface roughness

Research Outline

- Identify Post-Processing technologies for external surfaces roughness reduction of Laser Powder Bed Fusion (L-PBF) parts.
- Compare external surface finish results based on Amplitude (Sₐ, Sₐₐ) and Functional (Sᵥ, Sᵥ/vₐ, Sᵥ/vₐ/vₐ) surface texture parameters.

Laser Powder Bed Fusion (L-PBF) benchmark sample and external surfaces under analysis

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Surface Roughness Measurement results

Fig. 1: 316L (1.4404) Metal Additive Manufactured sample design, SLM©280 machine, from SLM Solutions Group AG, with 2x 700 W lasers. The powder material was atomized with nitrogen gas to spherical particles size 10-45 µm with an apparent density of 4.57 g/cm³. Chemical properties follow the ASTM F136/A276.

Fig. 2: As-printed inspection locations and examples of the respective surface topographies. Surface roughness is measured using a confocal microscope Olympus® SX51, equipped with a 5x0 magnification objective (Numerical Aperture = 0.95). Measurements were repeated five times.

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Conclusion

- Preliminary vibration deburring reduces the As-Printed surface roughness by a factor 2.7.
- Abrasion-based processes can reduce Sa down to 2.0 µm.
- Plasma electrolytic Polishing (PeP) and Dry ElectroPolishing promote the most Sa reduction, with average roughness below 1 µm.
- The skewness indicates a predominance of valleys in the case of the PeP process compared to Dry ElectroPolishing. This is confirmed by the higher Sᵥ/vₐ/vₐ ratio in comparison to Sᵥ/vₐ ratio.