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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 (S_a, S_{sk}) and Functional (S_k, S_{pk}/S_k S_{vk}/S_k) surface texture parameters.

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

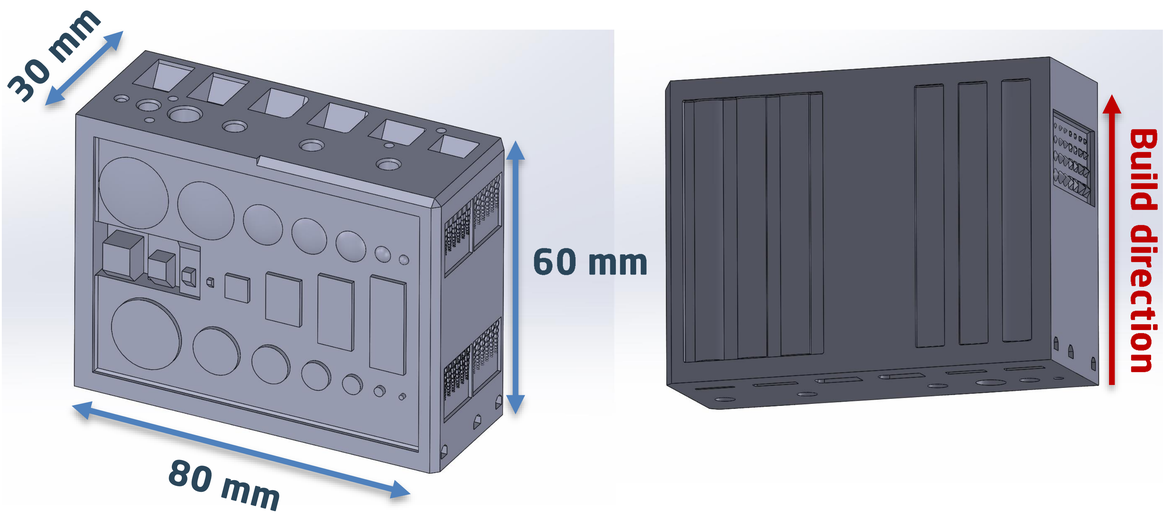


Fig. 1: 316L (1.4404) Metal Additive Manufactured sample design. SLM©280 machine, from SLM Solutions Group AG, with 2x 700 W lasers. The powder material was atomized with nitrogen gas to spherical particles size 10-45 µm with an apparent density of 4.57 g/cm3. Chemical properties follow the ASTM F138/A276.

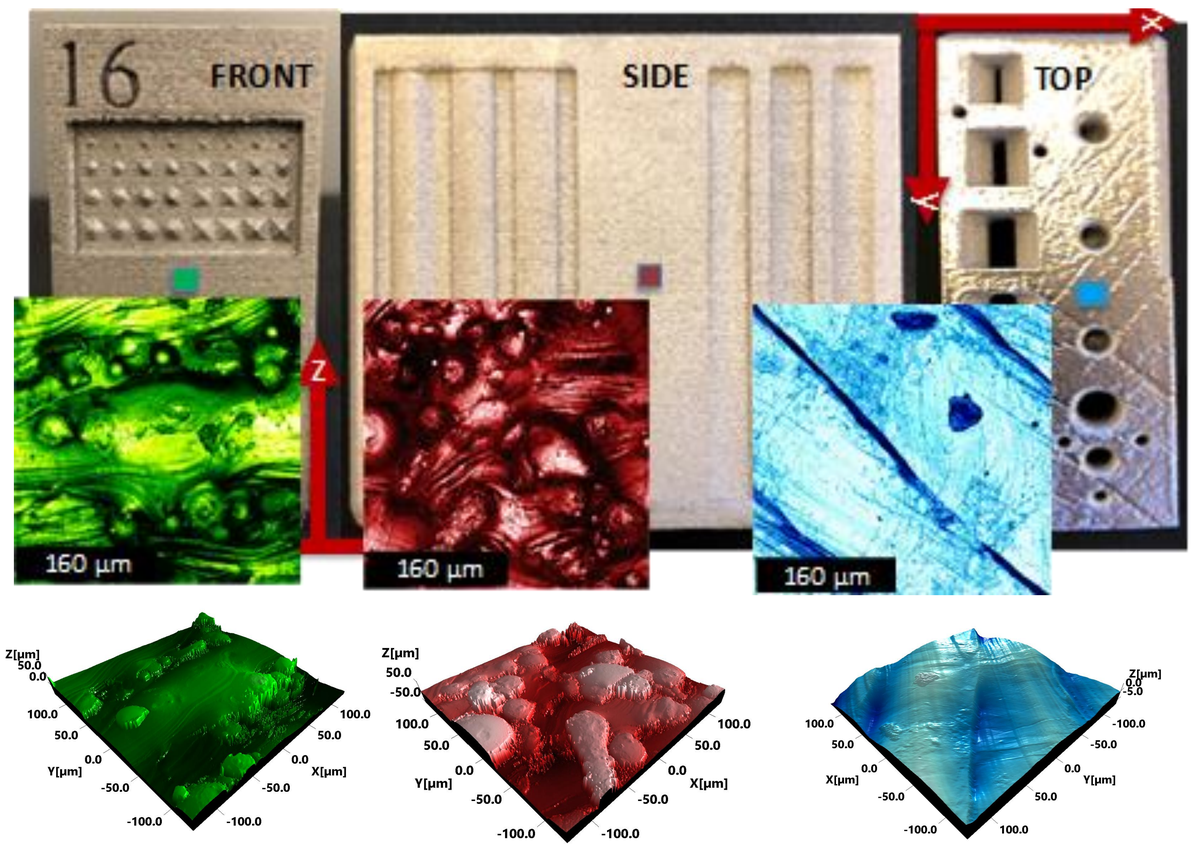
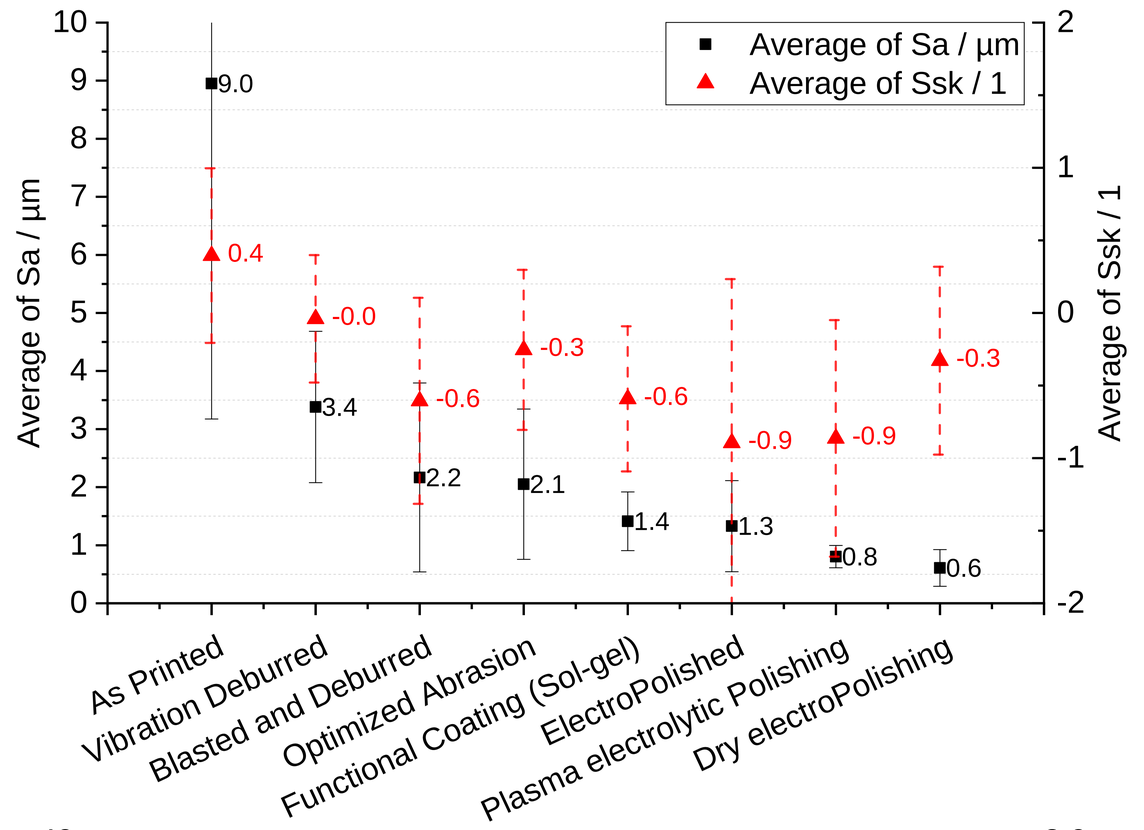


Fig. 2: As-printed inspection locations and examples of the respective surface topographies. Surface roughness is measured using a confocal microscope Olympus® lext OLS 4100, equipped with a 50x magnification objective (Numerical Aperture = 0.95). Measurements were repeated five times.

Surface Roughness Measurement results



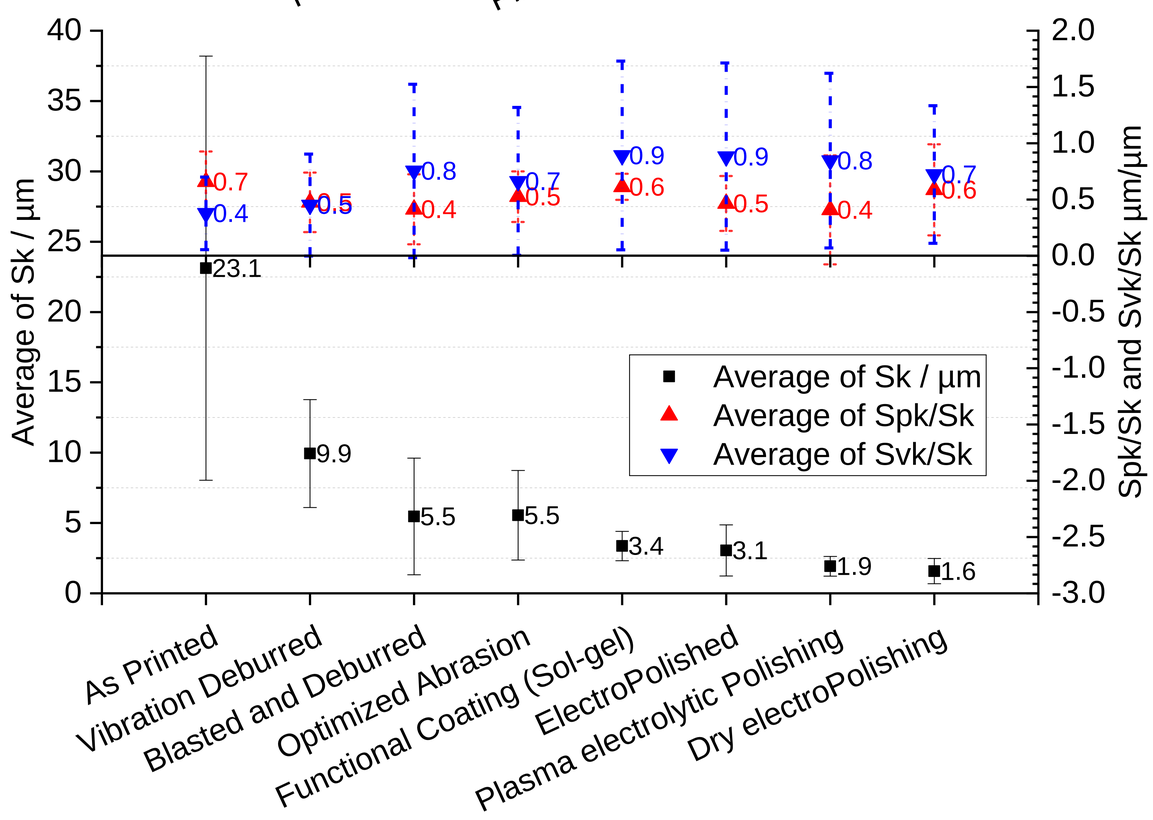
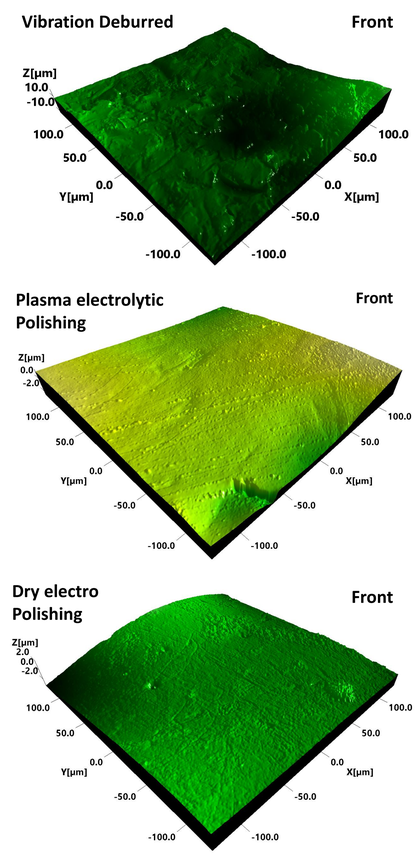


Fig 3. Comparison of S_a and S_{sk} (top) on the average measurements results calculated on the average of the five repeated measurements for the three orientations in analysis. The Post Processes: Vibration Deburring [1], Glass Blasting [2] and Deburring, Optimized Abrasion, Functional Coatings [3], ElectroPolishing [4], Plasma Electrolytic Polishing [5] and Dry ElectroPolishing [7] are compared to As-Printed Parts.

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 S_{vk}/S_k in comparison to S_{pk}/S_k ratio.



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