Reflectance investigation on ultrashort pulsed laser generated surface microstructures

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Recent advances in ultrashort pulse laser-based surface structuring have gained significance due to their durability as well as their minimal chemical and mechanical impact on the substrate. By applying multiple ultrashort laser pulses onto a surface, the surface is roughened, resulting in the formation of microstructures such as Laser Induced Periodic Surface Structures (LIPSS) [1] or Cone Like Protrusions (CLPs) [2]. To achieve high-contrast markings, a characterization of the reflectance properties of such structures is necessary. Therefore, not only the direct reflection, but also the diffuse reflection of the marked surface characterizes their optical appearance, as the periodic structures scatter light [3].

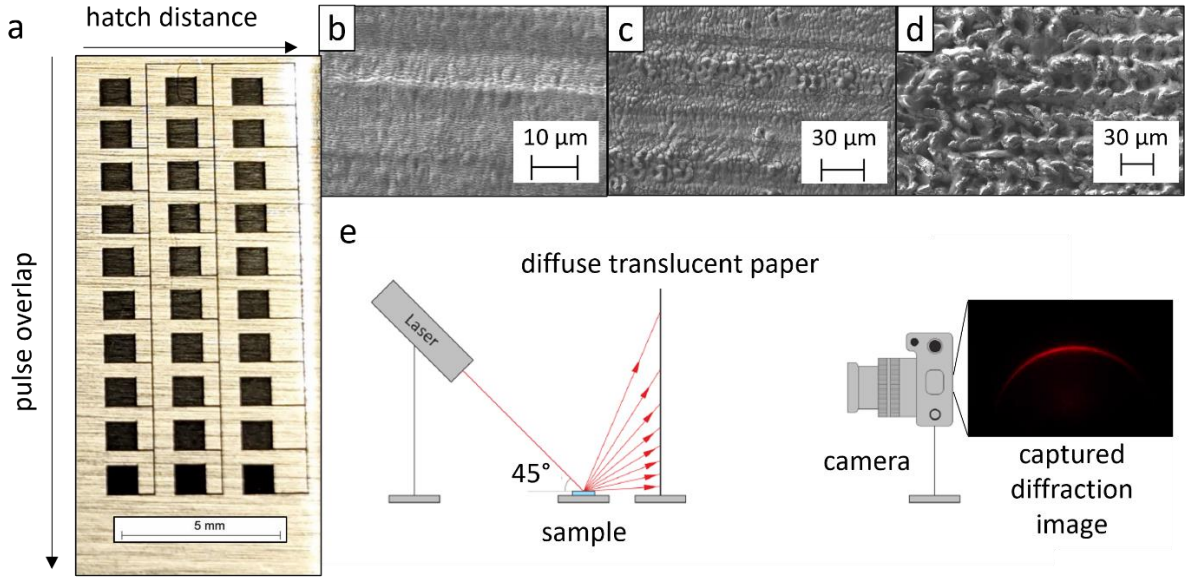

Figure 1: (a) Blackened stainless steel surface processed with different pulse overlap and hatch distance, (b) LIPSS-covered surface, (c) transition from LIPSS to CLP structures, (d) CLP structures, (e) reflection characterization setup.

In this work, a setup containing an 800 nm Ti:Sa laser and a galvo scanner was used to create the different types of microstructures. The blackening of the surface at different processing parameters (see Figure 1 a-d) was characterized by illumination with a helium-neon laser and simultaneous projection of the scattered light onto a diffuse translucent paper, which was then captured with a camera (see Figure 1 e). The number of pixels whose intensity exceeds a threshold value serves as an indicator of reflectivity.

References: [1] Neugebauer, C., Quaranta, S., Ehrenmann, S., Rest, C., & Sadowitz, J. Proc. SPIE 10906, Laser-based Micro- and Nanoprocessing XIII, 1090604 (2019); [2] X. Li, M. Li, H. Liu, Chin. Opt. Lett. 19, 51401 (2021); [3] S. Maragkaki, C.A. Skaradzinski, R. Nett, E.L. Gurevich, Scientific reports 10, 53 (2020)