

# Laser microprinting dynamics and scalability

Janko Tuta<sup>1</sup>, Jaka Mur<sup>1</sup>, and Rok Petkovšek<sup>1\*</sup>

<sup>1</sup> University of Ljubljana, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia

\*Corresponding author email: rok.petkovsek@fs.uni-lj.si

Laser microprinting, by laser-induced reduction of metal salts, is a promising new additive manufacturing technique and alternative to metal inkjet printing and laser-induced forward transfer printing due to higher precision, better conductivity, and multi-material printing capabilities [1, 2]. Silver metal structures on dielectric substrates were fabricated with a custom 515 nm fiber based laser with ultrashort 500 fs pulse duration and capable of up to 30 MHz pulse-on-demand operation [3, 4]. Due to a wide parameter space initial formation of the silver deposit and its growth upon substrate illumination were closely examined. Effects of laser parameters such as pulse frequency, pulse energy and incident pulse count were studied by measuring the deposited metal volume after a set number of pulses with a confocal microscope. Furthermore, we dynamically tracked the growth of deposited silver size with a high-speed camera. With deposited volume measurements we find a correlation between the final volume and the number of incident laser pulses for a set pulse energy. However, the deposited volume reaches a plateau after a set number of pulses where the deposition rate lowers significantly. We find from the high-speed camera measurements that the pulse frequency plays a crucial role on the dynamics of the silver structures growth, where higher pulse frequencies increase the deposition rate. Pulse frequency of 30 MHz resulted in the highest silver deposition rate, leading to further scalability of the technique using high repetition rate laser sources.

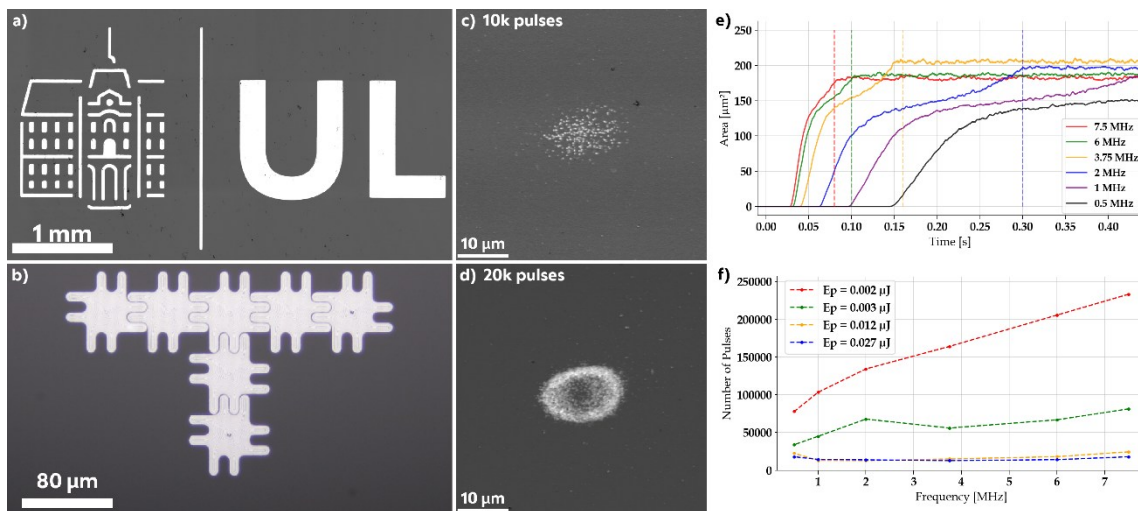


Figure 1: a) University of Ljubljana logo printed in silver on glass. b) EWOD electrodes pattern printed in silver on glass. c) Deposited silver after 10k pulses. d) Deposited silver after 20k pulses. e) High speed camera measurements of silver deposition in spots (c-d). f) Threshold number of pulses for 50 μm<sup>2</sup> spot size in relation to pulse frequency.

## References:

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