



PHOTONICS PUBLIC PRIVATE PARTNERSHIP



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## PoLaRoll - Polygon scanner based ultra-short pulse laser processing in roll-to-roll manufacturing

# PoLaRoll

Project Duration:

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Research & Innovation Action

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Development of ultra-  
short pulse laser  
ablation process for roll-  
to-roll products

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## EXECUTIVE SUMMARY

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This scientific report shows the main correlations between laser process parameters and process results as well as limitations and requirements for the polygon based process.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 723805.

## 1 MAIN CORRELATIONS BETWEEN PROCESS PARAMETERS AND RESULTS

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The laser structuring process is needed to ablate the lacquer specifically from the metal substrate. In extensive parameter studies, process parameters have been determined in order to achieve a complete removal of the lacquer coating. The target of the studies was to determine the minimum pulse energy and the minimum effective number of pulses that ablates the lacquer completely for an existing laser with the correct beam waist radius of about 22  $\mu\text{m}$ .

The following results have been obtained:

- For a pulse energy of 3.8  $\mu\text{J}$ , nearly the whole lacquer has been ablated for an effective number of pulses of about 20. Small residues might be present for this parameter set.
- For a pulse energy of 6.1  $\mu\text{J}$ , nearly the whole lacquer has been ablated for an effective number of pulses of about 20. Small residues might be present here. For the same pulse energy and an effective number of pulses of about 30, the lacquer has been completely ablated without any residues.

## 2 LIMITATIONS AND REQUIREMENTS FOR POLYGON BASED PROCESS

From the results of the laser process investigations, requirements for the laser and scanner parameters can be deduced. The following values have been defined by the consortium for the target parameters of the final polygon setup:

- Web width: 30 cm
- Web speed: 0.3 m/min
- Inter-line distance: 5  $\mu\text{m}$
- Maximum power loss in the system: 30%
- Beam waist radius: 22.5  $\mu\text{m}$

Taking these values into account, the minimum required repetition rate, scan speed and average laser power in Table 1 can be derived. The average laser power is the required laser power for both laser beams.

Table 1 Laser and scanner parameters deduced from the process parameters.

Process parameters		Laser parameters		Scanner parameters
Pulse energy [ $\mu\text{J}$ ]	$N_{\text{eff}}$	Average laser power [W]	Repetition rate [MHz]	Scan speed [m/s]
3,8	20	207.9	19.1	300
6,1	30	499.7	28.7	300
6,1	20	333.7	19.1	300

However, so far, these are only preliminary results since all investigations have been carried out with an existing laser setup that differs substantially from the final setup. For example, the repetition rate of the final laser source will be much higher than for the laser used for the parameter investigations. So far, it is not clear whether the ablation results will be the same for the novel laser source.

## CONCLUSIONS

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As a conclusion, the main correlations between the process parameters and the ablation results have been shown. From these results, requirements and limitations for the laser and for the scanner have been deduced.