Parallel laser texturing with Diffractive Optical Elements for friction reduction in pistons

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It is well known that the friction between two different surfaces can be controlled by applying specific textures tailored to the application. Moreover, innovative machine learning methods can optimize surface texturing designs for various concrete applications, like friction optimization in piston seals [1]. In this regard, laser is a phenomenal tool for the fabrication of different patterns in flat and 3D surfaces. The flexibility provided by adjustable process parameters that can be modified, such as laser power, spot size, wavelength, pulse duration or repetition rates, enables the creation of surface patterns with a large range of shapes and sizes. Over the past few years, a great amount work has been devoted to the fabrication of textures with smaller and smaller features, reaching lateral sizes within the range of the micron, which has a strong impact on the productivity. Some of the most advanced laser texturing techniques require of the use of optics with high magnification or, in some particular cases, even complex optics. This makes the use of fast scanning strategies impractical, thus, point towards parallelization strategies as the most appealing approach to improving the productivity of laser texturing processes.
This work reports on the use of Diffractive Optical Elements (DOEs), in combination with high magnification optics, with the aim of tackling at the same time the optimization of the productivity of laser texturing processes for friction reduction applications that require of features with lateral sizes in the range of a very few microns. In this way the morphology, productivity and finishing of periodic textures fabricated making use of DOEs with different arrangements of split laser beams, in terms of number of parallel beams and physical distribution, will be presented and discussed, proving that Parallel laser texturing with DOEs is one of most effective solutions to reach high productivity with high lateral resolution.

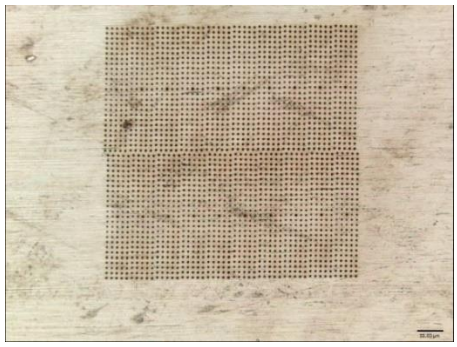

Figure 1: Array of dimples fabricated with a 25×5 parallel beams obtained with a single DOE.

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References:

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