# Shaping polymer surfaces by laser interactions: formation and nanomechanical properties of LIPSS in controlled enviroments

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Laser surface patterning techniques, such as the formation of Laser Induced Periodic Surface Structures (LIPSS), have demonstrated to provide versatility and reliability, constituting a possible method to obtain large processed surface areas in polymers [1]. The formation of LIPSS can be explained as the result of the interference between the incident and the surface-scattered waves, and a positive feedback process. This leads to the formation of structures with a spatial period close to the laser wavelength, i.e., in the 100 nanometer length-scale, and aligned parallel to the polarization of the laser beam [1,2].

In this work, we report the formation of LIPSS on free-standing films of poly(ethylene terephthalate) (PET) (Figure 1). The laser structuring process was carried out in different controlled environments: vacuum, oxygen, water, and ethanol. We evaluated the formation of LIPSS by Atomic Force Microscopy (AFM) imaging. The results were always compared to those found classically for the LIPSS formation in ambient conditions (25 ºC, 50 RH%). Our AFM structural analysis showed that in vacuum, the structuring process was similar to that performed in ambient conditions. However, for the rest of the atmospheres, we found different results. For water and oxygen, we observed the formation of LIPSS, but with different geometrical characteristics. In the case of ethanol, no LIPSS were formed, although the surface of the PET films showed changes. Furthermore, following our previous work [2], we performed a nanomechanical study on the nanostructured surfaces. We used the PeakForce QNM technique, an AFM-based protocol that allows obtaining the topography, elastic modulus, and adhesion maps of the materials simultaneously. Our results are discussed taking into consideration the possible physical and chemical changes that the samples might experience during processing, as well as the changes imposed by the complex geometry of the nanometric features.

## References

[1] E. Rebollar, M. Castillejo, T.A. Ezquerra, Eur. Polym. J., 2015, 73, 162.

[2] R. I. Rodríguez-Beltrán, D. E.Martínez-Tong, A. Reyes-Contreras, S. Paszkiewicz, A. Szymczyk, T. A.Ezquerra, P. Moreno, E. Rebollar. Polymer, 2019, 168, 178-184.

## Figures

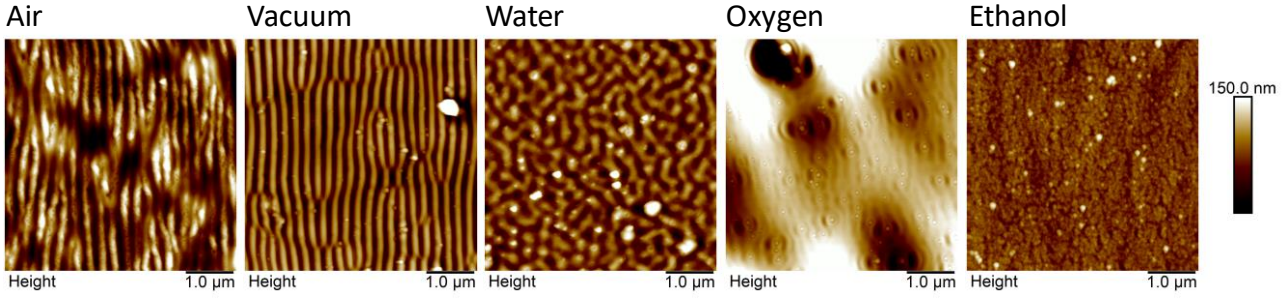


**Figure 1.** LIPSS on a PET free-standing film, prepared in different controlled environments.