Modification of polymers wettability by laser irradiation with nanosecond and femtosecond pulses

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The wettability of materials is determined by the topography and chemical composition of their surface. Natural examples, like the lotus leaf with its superhydrophobic properties [1], inspire techniques for controlling wettability. Laser methods, such as Laser Interference Lithography, Laser-Induced Periodic Surface Structures (LIPSS), or ablation, are used to modify polymer surfaces [2]. LIPSS formation in polymers alters their topography and induces slight oxidation, typically decreasing contact angles [3]. Laser ablation or foaming are effective for generating hydrophobic surfaces [4]. Ablation parameters such as repetition rate, pulse duration, irradiation wavelength, fluence, and number of pulses significantly influence the process [5].

This study explores the wettability of polymers with varying initial wettabilities ranging from hydrophilic to hydrophobic, and different absorption and thermal properties, after laser irradiation. Femtosecond (fs) and nanosecond (ns) laser pulses were used. In particular, for fs pulses, polymers are irradiated at 795 nm wavelength with different fluences and number of pulses. For ns pulses, three wavelengths (266 nm, 532 nm, and 1064 nm) and varying pulse numbers are employed. Contact angle measurements are used to assess wettability changes, and the different results obtained are explained on the basis of the chemical and morphological modifications analysed by x-ray photoelectron spectroscopy and scanning electron microscopy, respectively.

Acknowledgements: The authors would like to thank the projects PID2019-106125GB-I00, PID2020-119003GB-I00 and TED2021-131914B-I00 funded by MCIN/AEI/10.13039/501100011033 and "ERDF A way of making Europe" and J.P. Sánchez for the technical assistance.

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