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Understanding super-hydrophobicity: combined control of surface texturing by plasma etching and of surface chemistry by PECVD

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The importance of the role played by polymer morphology in controlling the surface properties is well known and worth of the great deal of papers published in the last 10 years. Materials engineers try to draw from the natural world the ability of developing properties such as self-cleaning, super-adhesion, anti-reflection, friction reduction in fluids, by combining in polymer surfaces micro- and nano-textures with proper chemistries. This approach can find application both in high-value technologies, such as those for the development of MEMS, drug delivery systems, advanced optoelectronics, and in some more traditional and low-cost products: windows (buildings and transportation), technical clothes, swimming suits, glasses.
In this contribution we present our advances in the field of plasma etching as a versatile technique for texturing surfaces at nano-levels. This has been proved to be promising in order to provide polymers with superior wetting and optical properties by generating in few minutes relieves, ranging from dots to columns, uniformly distributed onto the surface.
In this contribution particular attention has been devoted to the etching process of polystyrene, clarifying the role of each parameter/factor in initiating and developing the un-homogeneous etching: gas feed (fluorine-, hydrogen- and oxygen-containing, contribution of the inert gas); input power; substrate biasing and location; substrate temperature; presence of metal oxides.
In order to gain a deeper understanding of superhydrophobic anti-adhesive wetting of these textured surfaces we have independently tuned the texture and surface chemistry, by combining in a single-batch experiment etching and plasma deposition. The latter process has been performed at variable hydrocarbon-to-fluorocarbon gas feed ratio. This approach allowed to give a rationale to the phenomena of the liquid-textured solid interfaces in the frame of the Cassie-Baxter theory, finding that the fluorine-to-carbon ratio affects the wet fraction of surface profile, likewise the a priori modelling of topographical features.

Keywords
plasma texturing
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