Low energy plasma immersion ion implantation for controlling the wettability of propylene

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Abstract

Superhydrophobicity is an effect of unusual and intense water repellency, caused by a particular combination of surface roughness and chemical composition. It is especially interesting in engineering and biotech applications, due to some properties that superhydrofobic surfaces present such as anti-sticking, anti-contamination, and self-cleaning. This interest associated to the fact that many functional polymers have progressively substituted traditional materials (ceramics, glasses, and metals) impels the research in new processing methods for production of superhydrophobic polymers in a low-cost and rapid way. In this work a two step plasma treatment for modification of polymers surface is presented. Polypropylene (PP) samples were first exposed for 3600 s to 5 Pa argon/oxygen plasmas, excited by the application of 100 W of radiofrequency power to the sample holder (lower electrode), leading to low energy ion bombardment of the polymeric samples. The gases proportion was varied from 0/100 % to 100/0 %, for Ar/O2 ratio, keeping constant the total pressure of the mixture (5 Pa). A subsequent fluorination treatment of 300 s was performed in a 13 Pa SF6 plasma generated by the application of 70 W of radiofrequency power to the upper electrode while grounding the sample holder. The etching rate (mass) of the samples increased (decreased) as the O2 proportion in the plasma phase increased. Contact angle measurements revealed hydrophilic surfaces just after argon/oxygen treatment, and hydrophobic ones immediately after exposure to SF6 plasma. The hydrophobic surfaces were converted into superhydrophobic ones with increasing the aging time in air. X-Ray photoelectron spectroscopy analysis revealed an increment in the oxygen proportion on the surfaces immediately after the bombardment procedure and fluorine incorporation following the fluorination procedure. Surface profiles acquire by atomic force microscopy and micrographs generated from scanning electron microscopy allowed to evaluate the effect of the surface morphology and topography on the wettability results.

Keywords: polypropylene, wettability, plasma immersion ion implantation

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