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Polyethylene surfaces by plasma nanotexturing from superhydrophilicity to superhydrophobicity with high adhesion and superhydrophobicity with low adhesion

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Plasma nanotexturing has attracted considerable attention as an effective way by using plasma technology to fabricate the functional nanopatterns with antireflection, superhydrophobicity, gecko-like adhesive, and nanoscale semiconductor. However few studies on the aging of the polymer surfaces by plasma nanotexturing were reported. In this work, the polyethylene (PE) surfaces were modified by oxygen capacitively coupled radio frequency plasma (CCP) nanotexturing under a radio frequency (RF) power of 200 W for the exposure time of 10 min and 20 min. The aging of the wettability of the PE surfaces was studied in air at the different temperature of 20º C , 60º C and 90º C for the aging time up to 24 hr. The nanowires formed on the PE surfaces by the oxygen CCP nanotexturing under 200 W for 10 min and 20 min. The as-modified surfaces with nanowires were superhydrophilic with contact angle of approximately 0º. The contact angle above 150º was obtained on the post-aged surfaces at the aging temperature of 20º C during the aging time of 24 hr and the water droplet did not roll off the surfaces at any tilted angles.The post-aged surfaces became superhydrophobic and showed high water adhesion. As the stable superhydrophobicity with low water adhesion was achieved on the post-aged surfaces during aging at 60º C and 90º C, the water droplet can spontaneously roll off the tilted surfaces. The sliding angles gradually decreased with the increase of the aging time and reached 2.6º at 90º C for the aging time up to 24 hr. The evolution of the wettability of the post-aged PE surfaces, from superhydrophilicity to superhydrophobicity with high adhesion, and superhydrophobicity with low adhesion, could be due to the surface restructuring, i.e. the diffusion of numerous mobile polar oxygen-containing groups into the polymer and the simultaneous emergence of nonpolar polymer chains to the surface, on the surfaces with nanowires during aging.

Keywords
Plasma nanotexturing
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