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Superhydrophobic nanostructured non-woven fabric using plasma modification

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We describe fabrication of superhydrophobic surface on non-woven fabric (NWF) having nano-hairy structures and a hydrophobic surface coating. Oxygen plasma was irradiated on NWF for nano-texuring and a precursor of HMDSO (Hexamethydisiloxane) was introduced as a surface chemical modification for obtaining superhydrophobicity using 13.56 MHz radio frequency-Plasma Enhanced Chemical Vapor Deposition (rf-PECVD). O2 plasma treatment time was varied from 1 min to 60 min at a bias voltage of 400V, which fabricated pillar-like structures with diameter of 30 nm and height of 150 nm on NWF. Subsequently, hydrophobic coating using hexamethyldisiloxane vapor was deposited with 10 nm thickness on NWF substrate at a bias voltage of 400 V. We evaluate superhydrophobicity of the modified NWF with sessile drop using goniometer and high speed camera, in which aspect ratio of nanohairy structures, contact angle and contact angle hysteresis of the surfaces were measured. With the increase of aspect ratio, the wetting angle increased from 103° to 163°, and the contact angle hysteresis decreased dramatically below 5^{o}. In addition, we had conducted experiment for nucleation and condensation of water via E-SEM. During increasing vapor pressure inside E-SEM from 3.7 Torr to over 6 Torr which is beyond saturation point at $2^{o}C$, we observed condensation of water droplet on the superhydropobic NWF. While the condensation of water on oxygen plasma treated NWF (superhydrophilic) occurred easily and rapidly, superhydrophobic NWF which was fabricated by oxygen and HMDSO was hardly wet even under supersaturation condition. From the result of wetting experiment and water condensation via E-SEM, it is confirmed that superhydrophobic NWF shows the grate water repellent abilities.

Keywords: non-woven fabric, superhydrophobicity, E-SEM