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Improvement of mechanical strength of hydrophobic coating on glass surfaces by an atmospheric pressure plasma jet

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Abstract: Non-thermal plasma is getting more popular in industrial applications, mainly treatment of material surfaces. Hydrophobic coatings often suffer mechanical instability and do not function well after abrasion/scratching. In this study, non-thermal plasma jet generated at atmospheric pressure in ambient condition was applied to the hydrophobic treatment of glass surface using two precursors. Tetramethylsilane (TMS) was used to promote hydrophobicity and (3-Aminopropyl)triethoxysilane (APTES) was used to get durable mechanical strength of the coating although it is hydrophilic in character. An alternating current (AC) high voltage (operating frequency: 11.5 kHz) was used to generate plasma jet for producing a coating layer onto the soda-lime glass sample. Water contact angle of 139° and a stable mechanical strength were achieved at an optimal TMS/APTES ratio of 4.8. The coating thickness, strength and water contact angle were varied by changing treatment time, applied voltage, and carrier gas (argon) flow rate. The coating layer were characterized by atomic-force microscopy (AFM), scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FTIR), water contact angle (WCA), scratch test and UV/visible spectroscopy.

Keywords: non-thermal plasma, atmospheric pressure plasma jet, hydrophobic coating