Contribution ID: **159** Type: **Oral Presentation**

Influence of Contamination on the Hydrophobic Properties of Plasma-treated Silicone Rubbers

Tuesday 5 June 2018 11:15 (15 minutes)

Hydrophobicity is the key factor for silicone rubbers to fabricate insulators under polluted and wet conditions. The influence of contamination on the hydrophobic properties of plasma-treated silicone rubbers (SR) was investigated in this paper. The hydrophobicity properties of silicone rubber were determined by the static contact angles between the droplet of distilled water and the horizontal surface of the silicone rubbers. Atmospheric pressure plasma jet was applied to treat silicone rubbers with three surface conditions: clean surface, surface polluted by solid layer method and polluted surface using plasma jet treatment as pretreatment.
The results showed that clean SR lost its hydrophobicity rapidly under plasma jet and subsequent hydrophobicity recovery was slower. In contrast, polluted SR surface changed from hydrophobic state to hydrophilic state with contact angle of 120° after 1 min treatment. The polluted surface could keep its hydrophobicity after 200 hours. The silicone rubber under the third condition also became hydrophobic after plasma jet treatment but the process was slower than polluted surface without pretreatment.
The surface was examined under scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), energy dispersive X-ray (EDS) spectroscopy and fourier transform infrared (FTIR) spectroscopy. SEM and XPS showed clean SR surface became rough while organic surface was destroyed gradually and inorganic layer appeared with plasma jet treatment. EDS and FTIR showed that organic groups appeared on the polluted SR surface and made it hydrophobic.

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Session Classification: Oral 6 - Magnetic & Arc Phenomena

Track Classification: Plasmas, Discharges, and Electromagnetic Phenomena