Surface Modification of Polytetrafluoroethylene by Atmospheric Pressure Plasma of Dielectric Barrier Discharge with Ar/Liquid Vapor Mixture Gas

Hideki Yajima[1], Izumi Serizawa[1], Masahiko Tani[2], Hiroshi Furuta[2], Akimitsu Hatta[2]
[1]ORC Manufacturing Co., Ltd., Chino, Japan [2]Kochi University of Technology, Tosayamada, Kami, Kochi, Japan

h-yajima@orc.co.jp

For variety of industrial application of Polytetrafluoroethylene (PTFE), it is required to improve the surface property of poor adhesion with other materials. Plasma surface treatments have been expected to modify the PTFE surface and some successful results have been reported. Atmospheric pressure plasma techniques have many advantages for treatment of polymer surface; no usage of vacuum system, simple configuration of apparatus, high density plasma for rapid treatment, small environmental impact, and so on. It is expected to rapidly prepare hydrophilic surface with improved adhesion on PTFE by atmospheric plasma irradiation.
We have been studying on surface modification of PTFE by atmospheric pressure plasma using mixture gas of Ar and some kinds of liquid vapor. A dielectric barrier discharge was operated in a simple configuration of parallel electrodes, i.e., in a small gap between a pair of glass plates with a pair of parallel electrodes stuck on both the outsides of the glass plates. A sample of PTFE sheet was placed on a lower glass plate with remaining small space for plasma production between the specimen and the upper glass plate. Ar gas was bubbled in liquid in a bottle for supplying the liquid vaper and the mixture gas was fed into the discharge gap. As the reactive vaper of liquid, ultrapure water, methanol, ethanol, 2-propanol and acetone were examined.
After plasma treatment for 10 seconds, the static water contact angle was measured. In all the cases, the water contact angle was significantly decreased from the original surface. By using methanol or ethanol, hydrophilic surface of 20º to 30º contact angle was achieved while the original surface showed 109º. It has been confirmed that atmospheric pressure plasma treatment using our designed configuration with Ar/liquid vapor mixture gas can be useful for PTFE hydrophilization.

Keywords
Surface modification
Polytetrafluoroethylene
Atmospheric pressure plasma
Dielectric barrier discharge