Study of the surface properties of HMDSO/O_2 plasma treated polyethylene terephtalate

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Abstract:

Polymers are applied widely in modern industry and act as very important roles for many obvious advantages such as low density, versatile electronic properties, chemical inertness, and low cost. However, the surface modification of these polymers continues to play an increasingly important role in many industrial applications. In the literature, organosilicon thin films elaborated by plasma polymerization have attracted great interest for both fundamental researches and practical applications such as protective coatings, water repellency coatings, chemical barrier coatings, microelectronic and printing. Increasing film hydrophobicity will affect the film barrier property and makes the film useful in food and pharmaceutical packaging. However, increasing film hydrophylicity, affect the wettability and the biocompatibility making the film useful for microelectronic and biomedical applications. Hexamethyldisiloxane (HMDSO) is one of the most common monomer used for polymer layer depositions (PHMDSO) on various substrates.

In this work, we have been interested in the study of the surface properties of polyethylene terephtalate (PET) films 20 µm thick, coated by thin layers deposited from pure hexamethyldisiloxane (HMDSO) vapours and diluted with oxygen in low frequency powered plasma reactor (19 kHz). The surface characterization of the PET film was carried out using water droplet contact angle measurements, surface potential decay (SPD) and Fourier transform infrared spectroscopy (FTIR). Correlation between these different analysis techniques results has been discussed. The surface wettability of the PET film monitored by contact angle measurements showed considerable improvement when treated with plasma coating. The water contact angle was increased from 64° to 93° after 10 minutes of HMDSO plasma coating. FTIR spectrum showed the apparition of Si-CH_3, Si-O-Si and Si-C peaks after plasma coating which certainly results in the improvement of film hydrophobicity. The measurement of surface potential evolution after corona charge deposition recorded on treated and untreated PET showed slower charge decay for coated PET film, indicating the retention of deposited charges at the surface. However, for film coated with a mixture of HMDSO and oxygen (O_2), an opposite behavior has been observed. Contact angle decreased from the 93° for film coated with pure HMDSO to 47° for film coated with 10% of HMDSO and 90% of O_2. FTIR spectra showed the apparition of hydroxyl groups (OH) witch makes the film more hydrophilic resulting in wettability enhancement.

Keywords: Cold plasma; PET, HMDSO/O_2; Contact angle; SPD; FTIR