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Plasma Activation of PEN polymers by Diffuse Coplanar Surface Barrier Discharge and Low Pressure Ion Bombardment

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The polymers are important material for many applications from the flexible electronics (displays, solar cells) to biocompatible materials for implants and tissue engineering. Surface modifications of PEN polymers by the atmospheric low cost DBD plasma discharge in ambient air and nitrogen at atmospheric pressure were studied. The samples were treated in the 400 W powered DBD plasma discharge. The treating time was from 1 s up to 10 s. The comparison was made to low pressure experiments were done in situ at XPS system on the polymers with oxygen and argon, nitrogen and air ions from MW plasma at energies 200 eV and 2500 eV.An electro kinetic potential was also investigated on the modified surfaces over wide range of pH. The DBD plasma treatment of PEN had no significant influence on the surface morphology. But the water contact angle was reduced by the treatment form initial 79º to 31º (air) and 20º (nitrogen) when after 3 day at normal conditions the contact angles was still about 50º and 40º, respectively. The oxygen concentration in the PEN foil measured by XPS was increased from an initial 22 at.% up to 45 at. % already after 5s in DBD air plasma. The nitrogen DBD plasma modified surface composition only by implanted nitrogen up to 5 at. %. But the surface modifications in air plasma resulted in the formation of new chemical bonds between the carbon and the oxygen, e.g., C=O, O–C–O. The physical sputtering process is dominant for the treatment by argon ions at both energies and oxygen ions treatment at higher energy 2.5 kV in low pressure conditions. The O/C ratio decreases from initial value about 0.29 to 0.19 and 0.09 by argon ions treatment with energy 0.2 keV and 2.5 keV, respectively. In contrary the low energy 0.2 keV oxygen ions treatment can increase O/C ratio up to 0.43.

Keywords
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