PO1057

Infrared gas phase study on plasma-polymer interactions in high-current air-like dielectric barrier discharge

Yaoge Liu[1], Stefan Welzel[1], Serguei Starostin[2], Richard van de Sanden[1], Jan Bouwstra[2], Richard Engeln[3], Hindrik de Vries[1]

[1]FOM Institute-DIFFER, Eindhoven, Netherlands [2]FUJIFILM Manufacturing Europe B.V., Tilburg, Netherlands [3]TU Eindhoven, Eindhoven, Netherlands

Y.Liu@differ.nl

A high current diffuse dielectric barrier discharge (DBD) was operated in air-like gas mixture in an atmospheric-pressure roll-to-roll plasma reactor. The exhaust gas from the discharge was studied using a high-resolution Fourier-transform infrared (FTIR) spectrometer in the range from 750 to 3000 cm^{-1}. The absorption features of $H_xN_yO_z$, CO_x, and HCOOH (formic acid) were identified and used to establish production rates (X) for these stable products. The $H_xN_yO_z$ chemistry was discussed according to the reaction pathways for plasma remediation and can be characterised by $X(HNO_2)$ $<X(N_2O)$ $<X(NO_2)$ $<X(NO)$. In this study it was observed that HCOOH can be a sensitive indicator for the etching of the polymer substrate in which the oxygen content plays a main role. CO_x is produced at high rates as soon as the polymer etching occurs while other CO_x sources (e.g. impurities) are at least 1 order less efficient in production. OH cannot be observed in the absorption spectra because of its high reactivity and therefore short lifetime. But the increase in the production of HCOOH and HNO_2 when PEN etching occurs indicates that OH may be produced from the oxidation of PEN. The absence of O_3 is attributed to the high electric field and high power density (therefore high temperature) in this study.

Keywords
FTIR
infrared
molecule production rate
atmospheric pressure
plasma measurements