Cell repulsive/cell adhesive behavior on films deposited by an Atmospheric Pressure DBD fed with TEGDME aerosol

G. Da Ponte[1], E. Sardella[2], F. Fanelli[2], R. Gristina[2], P. Favia[2,3,4]

[1]*VITO, Flemish Institute for Technological research, Boeretang 200, 2400 Mol, Belgium;*
[2]*Institute of Inorganic Methods and Plasmas IMIP-CNR, Via Orabona, 4, 70126 Bari, Italy;*
[3] *Department of Chemistry, University of Bari, Via Orabona 4, 70126, Bari, Italy*
[4] *Plasma Solution srl, Spin Off of the University of Bari, Italy*
E-mail : gabriella.daponte@vito.be

Atmospheric pressure Dielectric Barrier Discharges (DBD) are new, challenging technology for surface modification, combining the benefits of an atmospheric operation mode with those of cold plasma. The interest in DBDs is growing also for thin films deposition and treatments for biomaterials [1, 2]. Our research is aimed to plasma-deposit PolyEthyleneOxide (PEO)-like coatings with DBD technology, with tunable properties from cell-adhesive (low retention of PEO structure) to non fouling (high retention of the PEO structure). Depending on their chemical composition such coatings can be synthesized with unique resistance to protein adsorption and cell-adhesion in water media, or with swelling properties for drug delivery systems. It is possible to tailor the biological response from cell adhesive to cell repulsive surfaces controlling the percent of ether groups (C-O-C, PEOcharacter) in the films, as already done in low pressure plasmas [3].

An homemade DBD reactor was used [4] fed with TetraEthylGlycolDiMethylEther (TEGDME) aerosol, chosen as suitable organic precursor for the coating deposition. A constant He flow (3.15 slm; aerosol flow) was addressed to generate the aerosol with a constant output atomizer (TSI, 3076); a variable He flow was used as carrier to transport the aerosol into the discharge. The effect of the applied voltage, V_a (6.5-8.5 kV_{pp}) and of the total flow, Φ_{TOT} (8-10 slm), i.e. of the dilution of the aerosol precursor in the plasma, was evaluated on the coating composition with water contact angle, profilometry and X-rays Photoelectron Spectroscopy (XPS).

In our defined conditions, the main parameter to achieve a significant modulation of the C-OC content was the total flow, i.e. the aerosol amount introduced in the discharge area, reached by changing the flow rate of the He carrier (+/- 1 slm) at a constant aerosol flow (3.15 slm). In this case, the chemical composition of the coating was nicely tuned resulting in an excursion of the PEO-character from 50 to 70 % at 10 slm and 8 slm, respectively. Once water stability was assessed on polycarbonate substrate by a proper modulation of the chemical composition in a multi steps approach, PEO-like samples were used for cell adhesion experiments. The cells behaviour on the modified surfaces is related to the percentage of ether groups in the coating: coatings with a ether content of 70 % deposited at 8 slm displayed very good non fouling cell repulsive properties, while cell adhesive film were obtained for an ether content of 50 % at 10 slm.

References

[1] Girard-Lauriault et al, Plasma Proc. Pol. 2, 263, 2005.
[2] Heyse et al, Plasma Proc. Pol. 5, 186, 2008.
[3] Sardella et al, Plasma Proc. Pol. 1, 63, 2004.
[4] Fanelli et al, Plasma Proc. Pol. 7, 535, 2010.