

# Polymerization of acrylic acid by atmospheric pressure plasma jet for cell adhesion applications

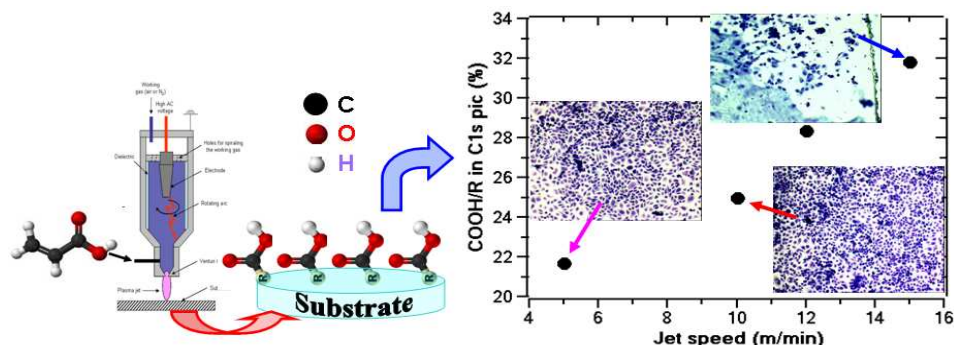
Olivier Carton, Dhia Ben-Salem, Sudhir Bhatt, Jérôme Pulpytel, Farzaneh Arefi-Khonsari

*Laboratoire de Génie des Procédés Plasmas et Traitement de Surface, Université Pierre et Marie Curie, ENSCP11 rue Pierre et, Marie Curie, 75231 Paris cedex 05, France*

E-mail: [farzi-arefi@chimie-paristech.fr](mailto:farzi-arefi@chimie-paristech.fr)

The stability of coatings obtained from plasma polymerization of acrylic acid (AA) has been widely studied at low pressure [1] and is an issue for its use in the biological applications. It is even more difficult to obtain stable coatings from AA by atmospheric pressure discharges. In this paper we report on thin film coatings obtained from AA with an atmospheric pressure plasma jet, an original and fast technique to grow organic thin films. Liquid acrylic acid was introduced directly in a nitrogen plasma jet which moved above a glass substrate to grow the thin films. OES has been used to follow the fragmentation of the precursor in order to obtain the maximum retention of the carboxylic coatings in the coatings. Several parameters were investigated such as the speed of the jet which defines the treatment time as well as the frequency of the discharge which monitors the power injected in the plasma. The typical treatment time to grow a film of roughly 1  $\mu\text{m}$  thick on a large surface (dozens of  $\text{cm}^2$ ) is in the order of only 30 seconds. FTIR and XPS have shown that the deposited films have typical chemical functions of acrylic acid. As the energy input in the plasma and in the growing film increases the retention of functional groups decreases. However the retention of carboxylic groups is always high and XPS shows that around 30% of the carbon atoms can be bonded to carboxylic groups (theoretical maximum of 33%). The stability of the coatings in water has been studied by gravimetric measurements. It appears that coatings deposited with lower energy are less stable. Moreover *after soaking in water for 24 hours*, a part of the thickness of the micrometer thick films is removed, as observed by weight loss measurements without any remarkable change in the chemical composition of the films.

NIH:OVCA-3 cancer cells were cultured in physiological conditions and were seeded in a microplate which was loaded with autoclaved coated glass cover slips for 24, 48 and 72 hours. The cell adhesion to the surface was determined by using an inverted microscope. Our results were correlated with the chemical structure of the films, as well as the important parameter which was the jet speed (Fig.1). The present study shows the possibilities to monitor the cell adhesion on surfaces presenting different carboxylic groups on the surface.



**Fig. 1:** COOH groups percentage of XPS C1s peak, as a function of the jet speed and Optical microscopy images of NIH:OVCA-3 cells on the resulting poly-acrylic thin film coatings.

## References :

- [1] R. Jafari, M.Tatoulia, W. Morscheidt, F. Arefi-Khonsari, *Reactive & Functional Polymers* 66 (2006) 1757–1765