Atmospheric pressure cold plasma functionalization of 3D polyurethane foams and heavy metal ions adsorption from water

Vincenza Armenise[1,*], Fiorenza Fanelli[2], Francesco Fracassi[1,2]

[1]*Department of Chemistry, University of Bari "Aldo Moro", via Orabona 4, 70126 Bari, Italy*

[2]*Institute of Nanotechnology (NANOTEC), National Research Council (CNR), c/o Department of Chemistry, University of Bari "Aldo Moro", via Orabona 4, 70126 Bari, Italy*

* vincenza.armenise@uniba.it

Atmospheric pressure cold plasmas have recently gained much interest in surface functionalization of materials thanks to the absence of expensive and complex pumping systems necessary for low pressure operations, the easy-to-handle apparatuses and their compatibility with continuous production processes [1-2]. A very actual issue is the processing of three-dimensional (3D) porous substrates. In fact, due to the achievable ignition of the discharge also inside the sub-millimetric pores, it can be possible to treat uniformly their outer and inner surfaces without effects on their bulk properties [3].

This contribution focuses on the application of dielectric barrier discharges (DBDs) to generate these plasmas and functionalize the surface of the entire structure of commercial 3D open-cell porous polyurethane (PU) foams. In particular, two different experimental strategies were used: I) the treatment using a DBD in parallel plate electrode configuration fed by helium and oxygen; II) the deposition of a coating containing carboxylic acid groups by mean of a DBD plasma jet in coaxial cylindrical configuration fed by helium, acrylic acid and ethylene [4]. The jet set-up was provided with a xy translator to allow the enlargement of the substrate area interested by the deposition. Both the approaches resulted in the ignition of the discharge outside and inside the foam and in an efficient functionalization of its outer and inner surfaces. The possible utilization of plasma modified samples for the adsorption of heavy metal ions from water was studied. The adsorption capacity of PU foams was significantly increased after both plasma processes.

[1] F.Massines, C.Sarra-Bournet, F.Fanelli, N.Naudè and N.Gherardi, *Plasma Processes and Polymers*, 9 (2012) 1041.

[2] F.Fanelli, *Surface & Coatings Technology*, 205 (2010) 1536.

[3] F.Fanelli and F.Fracassi, *Plasma Processes and Polymers*, 13 (2016) 470.

[4] P.Bosso, F.Fanelli and F.Fracassi, *Plasma Processes and Polymers*, 13 (2016) 217.