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Plasma Polymers: Evolution, Prospects, Promises and Challenges

Farzaneh AREFI-KHONSARI, A. Baitukha, J. Pulpytel, A. Valinataj Omran

Sorbonne Universités, UPMC Univ Paris 06, Paris, France

farzaneh.arefi@upmc.fr

In this talk, the state of the art on plasma polymers will be given. Atmospheric versus low pressure discharges, vapor vs aerosols, aerosols with solid nanoparticles, entrapment of biomolecules in aerosols will be discussed. Different nonequilibrium atmospheric pressure plasmas : planar DBD, single and double barrier DBD plasma jets, arc blown plasma jets and transported discharges in tubes will be discussed. The main advantages of the Atmospheric Pressure Plasma Jet (APPJ) systems are: i) separation between the plasma generation and plasma application regions, and ii) they can easily be integrated in already existing production lines for treating 2D and 3D structures. Arc blown discharges, moderately hot plasma jets ($T_g \sim 1000\text{K}$) can combine the rich plasma chemistry in nonequilibrium discharges with heat transfer phenomena. On the other hand deposition and surface treatment, by means of a He cold transported discharge in tubes as long as 200 cm and tube inner diameter ranging from 1 to 20 mm, can present a great potential for polymers used as biomaterials. PEG like polymers have been deposited by atmospheric discharges, however for particular plasma applications such as making a Drug Delivery System (DDS) based on several polymer or copolymer layers, encapsulating the drug, it is more reasonable to use a low pressure plasma which can give rise to dense crosslinked barrier films. The latter are less flexible and develop microcracks due to swelling and curvature of host biocompatible and biodegradable substrate. In order to obtain good cohesive coatings with excellent barrier and mechanical properties, it is very important to deposit layers presenting a vertical chemical gradient, where stress is gradually distributed over the rigid and flexible zones of the DDS, which is more easily deposited in low pressure plasmas. Our recent results in copolymerizing amphiphilic polymers for example for stimuli-responsive polymers and the use of biodegradable multi-layer copolymers for drug delivery applications will be presented.

Keywords

Plasma Polymers

APPJ

DDS

Transported Discharge

Biomaterials