Atmospheric plasma polymerisation of functional coatings: tailoring the final coating properties by the synergistic tuning of the plasma parameters, the precursor structure, the plasmagen gas and the injection mode

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The use of atmospheric plasma for the synthesis of functional coatings has led to hundreds of publications these last 10 years. Antibacterial, anticorrosion, optically active, biocompatible, self-cleaning, superhydrophilic, superhydrophobic, sticky or repellent surfaces were obtained thanks to the broad imagination of the scientific community. A wide variety of organic and/or inorganic precursors have been used combined with different plasma technologies. Most of the initial strategies were based on theories developed for low pressure (plasma) deposition. The first approach was mostly based on experimental studies where the effect of the change of some plasma parameters on the properties of the resulting final coating were investigated. However, such empirical approach, and the inherent difference between atmospheric plasma and low pressure plasma lead to some limitation in the development of new coatings. A relatively new approach tries to improve the properties of the coating through a deeper understanding of the physics and chemistry of the plasma itself, and its consequences on the growing film. An appropriate choice, or combination of precursors and an appropriate injection procedure have also a strong influence on the final coating. Finally, the drastic, and sometimes neglected, influence of the choice of the plasmagen gas will be exemplified.

Most of the examples presented in the talk have been obtained using a dielectric barrier discharge system, some with a RF torch, operating either with argon or helium as the main plasma gas. The plasma phase, or its post-discharge, is studied using atmospheric mass spectrometry (MS), optical emission spectroscopy (OES), and electrical measurements. The obtained coatings were characterized using infrared spectrometry (FTIR), X-ray photoelectron spectroscopy (XPS), secondary ion mass spectrometry (SIMS), (dynamic)water contact angle (WCA), atomic force microscopy (AFM), and profilometry.