Control strategies for AP-PECVD of fluorinated silane coatings

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Plasma enhanced chemical vapor deposition (PECVD) is a unique technique to produce coatings with characteristics suitable for a wide range of applications, including electronics, aerospace, and medicine [1]. Despite the technology is well-established at low pressure (LP), atmospheric pressure (AP) PECVD is receiving a lot of attention due to the absence of expensive vacuum equipment and the possibility of industrial on-line processing [2]. Whatever the pressure, researchers always had a strong interest in controlling the PECVD process by correlating the deposition conditions to the resulting coating properties [3]. To achieve this goal, the so-called Yasuda Parameter W/FM (where W is the discharge power and FM the precursor flow rate) was proposed for LP-PECVD processes [4]. Nonetheless, its implementation at AP has been questioned since the precursor is typically mixed with an inert gas, thus requiring a careful evaluation for each experimental setup [5]. In this work, the use of W/FM as control parameter for a PECVD process from an AP plasma jet and a fluorinated silane precursor is investigated. Attenuated total reflectance – Fourier Transform infrared spectroscopy and X-ray photoelectron spectroscopy results show that a tailored fluorine content in the coatings can be tuned according to W/FM: the lower is the degree of fragmentation of the precursor in the plasma discharge, the higher is the fluorine retention in the deposited coatings. These findings are further supported by water contact angle measurements which reveal a higher coating hydrophobicity for low W/FM values. Scanning electron microscopy images indicate that W/FM affects the deposition rate while not inducing substantial differences from a morphological point of view. Moreover, it is shown that coatings deposited under the same W/FM obtained with different combinations of discharge power and precursor flow rate exhibit same chemistry and wettability, suggesting the validity of W/FM as control parameter. Since the interest towards the AP-PECVD of fluorinated silane coatings arises from the need to develop new antimicrobial biomaterials for orthopedic implant applications, preliminary biological results of the antimicrobial activity of the deposited coatings are presented.

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