Insight into plasma polymerization of cyclopropylamine in low pressure capacitive RF discharges

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Materials modified by thin films with amine groups are promising for many bioapplications. It requires tuning the film stability in aqueous media because nitrogen(amine)-rich PPs tend to dissolve and lose the nitrogen functionalities by hydrolysis [1]. The stability can be improved by an increase of plasma power at the expenses of amine concentration in the films [2]. Recently, we started a series of studies with PP of cyclopropylamine (CPA) in argon capacitively coupled plasma, either at the floating [3] or RF-biased potential [4]. At certain conditions, the PP-CPA films deposited at the floating and RF-biased surfaces had similar concentration of NH_2 groups but better water stability was achieved at the RF electrode due to better cross-linking. The stability in water turned out to be more important than the amount of NH_x groups in the studies of mouse muscle myoblasts viability [6], whereas the performance of the films deposited at the floating potential was much better in the immobilization of biomolecules [5].

This work provides insight into fundamental aspects of the CPA plasma polymerization by putting together the results from electron beam experiments with CPA molecule, molecular dynamics simulations of CPA/Ar plasma interaction with surfaces and direct investigation of the CPA/Ar plasma. The plasma phase processes were investigated by mass/ion spectrometry and optical emission spectroscopy, whereas surface processes, mainly the ion bombardment, were studied by retarding field energy analyzer.

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