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Carboxylic groups functionalization by methacrylic acid deposition via PECVD for biomolecular applications

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Polymerization of methacrylic acid precursor was carried on in argon atmosphere by RF-PECVD technique using capacitive coupled pulsed plasma. The carboxylic functionalization was performed on different substrates: silicon nitride, silicon wafers and Petri dishes. The chemical structures and water stability of films obtained were investigated with regard to the RF power and pulsing (30 Hz) duty cycle (10 - 100 %) effects, gas and precursor fluxes. The surface composition of the coatings as well as their stability in water was investigated by X-ray Photoelectron Spectroscopy (XPS) measurements, FT-IR spectroscopy and Toluidine Blue-O assay (TBO). Coating wettability was measured by water contact angle (WCA) and our films showed a moderate hydrophilicity (WCA 30° - 50°). For lower RF-power and duty cycle a higher density of carboxylic groups could be obtained competing with a lower stability due to the lower degree of polymerization. In order to evaluate the coating stability, TBO test was performed on an as-deposited sample and a soaked one in water for 120 hours at room temperature to obtain the density of the carboxylic groups. Stable coatings in water solution were obtained with an unchanged density of carboxylic groups 120 hours in water of about 10^{-8} moles/cm². The plasma functionalization was performed also on microscope glass slides that were used for DNA microarray experiments; this approach was also used for cell microarray assay. For the DNA microarray experiments the plasma treated surface was activated to be able to bind biomolecules, such as DNA oligonucleotides: fluorescent DNA probes were linked to the surface and the behavior of the fluorescent signal was monitored. Substrates were incubated in water and in salt buffer solution up to 120 hours and the collected data showed that fluorescence intensity is stable and its value decreases by only 30% after 120 hours.

Keywords

plasma polymeritation
methacrylic
DNA microarray, culture cell