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A novel plasma jet with RF and HF coupled electrodes: jet characterization and effects on the surfaces

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The goal of achieving low temperatures and high plasma density is sought since many years. These requirements are needed to treat sensitive substrates from polymers to living tissues. At the same time chemical precursors used for surface functionalizations have to maintain their organic structure and keep high process efficiency. The two requirements usually are one against the other and the different solutions identified are the best achievable compromises.

Here, as a novel technical solution, we present a patented plasma jet where the coupling of RF and HF electrodes offers cold, stable and efficient conditions. The plasma is operated with argon as main process gas and it keeps its efficiency even with relatively high oxygen or precursors concentrations. Electrical, optical and temperature plasma jet characterization will be presented. In particular it will be highlighted the damping of the HF streamers by the RF plasma and the two frequencies plasma coupling like in a glow plasma. Optical and temperature measurement will highlight its low temperature processing, up to room temperature. In order to show its potential, it will be presented the deposition on a low melting substrate as polycaprolactone (PCL), the deposition of sensitive precursors using vapors of pyrrole monomer and the deposition of zinc oxide by aerosol of zinc acetylacetonate.

In order to highlight the peculiar features of the jet will be also presented the ion exchange in glass induced by the plasma jet, which allows also an easy patterning in the microscale of the ions in the glass at low temperature (about 150°C).

Keywords

atmospheric plasma jet
frequencies coupling
low temperature process