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(G*) Charaterization of aerosol-assisted low pressure plasma deposition processes

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Plasma-enhanced chemical vapor deposition is widely studied for deposition of functional thin films. For some applications, multifunctionality is a pre-requisite, and this can be achieved using a number of methods, among which is aerosol-assisted plasma deposition. Using a injector-reactor, stable but volatile liquids can be injected and pulsed into the discharge, resulting in a time-dependent plasma. The impact of pulsing argon into a low-pressure argon RF plasma was recently studied by optical emission spectroscopy with regards to the time-resolved electron number density and temperature. The present study builds on these results and characterizes the physics of a low-pressure capacitive RF plasma process assisted by pentane aerosols formed by pulsed liquid injection. In particular, time-resolved line emission intensities, pressure, and self-bias voltage of the plasma are measured. Low-pressure aerosols are injected either as mist (0.01-0.1 mL/min), mist plus droplets (0.1-1 mL/min), or only droplets (1-3 mL/min). Results show that increasing the amount of aerosol injected either by increasing the pulse frequency (while keeping the amount of liquid injected during a pulse fixed) or the amount of liquid injected during a pulse (while keeping the pulse frequency fixed) influence differently the pressure increase and self-bias voltage during each pulse. Over the range of experimental conditions investigated, the deposition rate of CxHy coatings rises with the liquid injection rate. However, by correlating plasma deposition rates with detailed aerosol characterization obtained by light scattering, it is found that droplet size play a significant role in the plasma deposition dynamics.

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