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ANALYSIS OF DIELECTRIC BARRIER DISCHARGES IN AR-MONOMER MIXTURES USING A STANDARDIZED FLUID MODELLING APPROACH

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Abstract. Thin film deposition enhanced by atmospheric-pressure plasmas has been widely studied over the past two decades (Massines et al. 2012). Nevertheless there is still a lack of comprehensive understanding, especially in identifying the particle species responsible for film formation. To address this issue, a study which combines fluid-Poisson modelling and experimental analysis of dielectric barrier discharges in argon with small amounts of siloxanes, organosilanes, or hydrocarbons is reported.

The applied fluid-Poisson model is a time-dependent, spatially one-dimensional model comprising balance equations for particle number densities and electron energy density coupled with Poisson's equation. Given the complexity of the reaction kinetic models under consideration, which involve hundreds of reactions, building the model by manually setting up each equation is laborious and prone to error. To overcome this, the model is generated automatically using standardized input files containing lists of the plasma species and plasma chemical reactions, together with the corresponding rate and transport coefficients, similarly as described in (Jovanović et al. 2021).

The present study investigates the behaviour of a single-filament discharge powered by sinusoidal voltages of a few kV at a frequency of 19 kHz. The analysis shows that Penning ionisation involving monomer molecules and excited argon species significantly influences the discharge characteristics. The analysis of surface fluxes of particle species emphasises the essential role of cations in the film formation process. The investigation further focuses on the contributions of specific cations and their correlation with the measured average mass of deposited ions. In addition, the influence of various chemical processes on the cation formation is discussed.

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