Title: Low temperature plasma and nanoparticles: effects of gas flow and surfaces

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Abstract: This PhD thesis investigates the role of carrier gas flow in the magnetron-based gas aggregation cluster source and its impact on nanoparticle transportation. The research encompasses both theoretical and experimental aspects of low-temperature plasma interaction with surfaces and material engineering applications. Numerical models and computational fluid dynamics simulations are employed to understand the underlying physics of nanoparticles motion in gas aggregation cluster sources. The study demonstrates that carrier gas flow, particularly its velocity and inlet configuration, significantly influences the nanoparticles trap region and their residence time in the plasma. Brownian diffusion is identified as a critical factor affecting the spatial behaviour of NPs, contributing to both their escape and loss in gas aggregation cluster sources. The deposition of thin films using magnetron sputtering of PLA, a promising polymer material, is shown to facilitate nanoparticle adhesion. This research enhances our understanding of non-electromagnetic aspects of nanoparticles behaviour in gas aggregation cluster sources, highlighting the value of computational fluid dynamics in optimising carrier gas flow performance in magnetron-based gas aggregation cluster source systems.

Keywords: low-temperature plasma, nanoparticles, gas flow, magnetron-based gas aggregation cluster source, computational fluid dynamics, CFD, optimisation