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(I) Challenges of thin film deposition by coupling a pulsed direct liquid injector and a dielectric barrier discharge

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Nanocomposite (NC) thin-films are widely studied due to the multifunctional properties they can develop (optical, electrical, mechanical). A lot of methods are under development with a real attraction for processes at atmospheric pressure, such as dielectric barrier discharge (DBD).
Recently, a new process of nanoparticles injection in plasmas has been developed [1]. This method consists in synthesizing the nanoparticles prior to their injection in the plasma in a low frequency pulsed injection regime. However, the impacts of the liquid pulsed injection on the DBD physics are still opening questions.
This work aims to study a pulsed-liquid-assisted DBD deposition process. In contrast with the continuous nebulization of solutions, pulsed injection causes a sudden increase of the quantity of precursor as droplets in the inter-dielectric space –the average velocity being in the 10 m/s range. We observed that depending on the process parameters (injection times, pulse frequency, continuous gas flow rate, etc.), the discharge stability is modified. These parameters are also critical for transport and evaporation of the droplets and so on the thin film deposition (here ppHMDSO). For example, by varying the different parameters of the pulsed-liquid-assisted DBD, we observe that the deposit can consist in different phases (liquid and solid) as a function of the time residency of the aerosol and the thickness of the deposited layer.
[1] Kahn, M., Champouret, Y., Clergereaux, R., Vahlas, C. & Mingotaud, A.-F. Process for the preparation of nanoparticles. (2016).

Keyword-1

Dielectric barrier discharges

Keyword-2

Thin film deposition

Keyword-3

Pulsed injection

Author: CACOT, Laura

Co-authors: Mrs KAHN, Myrtil (Laboratoire de Chimie de Coordination (CNRS)); CLERGEREAUX, Richard (CNRS); Mr NAUDÉ, Nicolas (LAPLACE, Université de Toulouse, CNRS, INPT, UPS); STAFFORD, Luc

Presenter: CACOT, Laura

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