Plasma / liquid interactions during low-pressure plasma sputtering dep-osition of Pt nanoparticles on liquid glycerol

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Résumé

Pt nanoparticles (NPs) are widely used as catalysts for oxygen reduction reactions (ORR) in electrochemical systems as the Proton Exchange Membrane fuel cell (PEMFC). NPs can be obtained through various physical, chemical or physicochemical routes. The chemical methods are very versatile in terms of controlling NPs shape and size but requires additives, which generate by-products difficult to remove and NPs with limited purity. In contrast, physical methods as magnetron sputtering on solid substrates avoid the use of additives, allowing the production of pure metallic NPs. In order to make the magnetron sputtering process compatible with conventional liquid ink preparation techniques used for manufacturing fuel cell, we recently reported the synthesis of Pt NPs over a host liquid substrate (glycerol) that sustains low pressures (1). Molecular dynamic simulations highlighted that the NPs diffusion in the liquid phase depends on the associated kinetic energy of Pt atoms when arriving on the liquid surface and so the plasma / liquid interaction properties. In this study, we investigated these interactions and the gas phase properties using experimental techniques as (an energy resolved) mass spectrometer and energy flux probe giving us access to the energy distribution of the sputtered species, total energy influx incoming onto the liquid and the gas phase composition. These results are correlated to the NPs physical properties obtained by X Ray Diffraction/Diffusion and High Resolution Transmission Electron, enabling us a better understanding of the Pt NPs growth phenomena on and in the liquid phase.

References:

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Mots-Clés: plasma sputtering, nanoparticles, plasma – liquid interactions

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