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CV/ biography

Françoise Massines is a senior scientist at the CNRS Processes, Materials and Solar Energy (PROMES) laboratory located in Perpignan, France. She received a doctorate in Physics from the University of Toulouse (1987). After five years of studying polymer physics at the Canadian National Research Council (CNRC) Industrial Materials Institute (IMI), she joined CNRS in 1989. Since that time her research activities have been devoted to atmospheric pressure plasma surface treatment. Her team at the Toulouse Electrical Engineering Laboratory (LGET - LAPLACE) was initially involved in polymer surface activation studies and later focused on the development of polymer thin film coatings. In 2007, she joined the PROMES laboratory and oriented her activities to atmospheric pressure plasma enhanced chemical vapor deposition (AP-PECVD) for photovoltaic applications focusing on nanocomposite thin film AP-PECVD. She was instrumental in the development of novel large area plasma sources. She is a coordinator of the IRN-NMC[1].

Plasma based solutions to produce nanocomposite thin film coatings

As part of the Franco-Canadian network on controlled nanomaterials (IRN NMC)[1], different plasma-solutions to produce nanocomposite thin films are investigated. The aim is to embed nanoparticles (NPs) in a plasma polymerized thin film. Different composites are considered: TiO_2/polymer, TiO_2/SiO_2, ZnO/DLC, Porous SiO_2/polymer, Au/polymer… The challenge is to form or inject the NPs avoiding their aggregations and to control their quantity and organization in the thin film. The key point is the control of the NPs size, quantity and dispersion in the thin film. Different plasma sources are studied; however, the presentation will be focused on DBD (dielectric barrier discharges) which are atmospheric pressure plasma useful for in-line coating of large surfaces.

Three different configurations are considered: the injection into the plasma of an aerosol of a dispersion of NPs in a polymerisable solvent, in-line formation of NPs upstream of the plasma and NPs formation in the plasma. The aggregation of the NPs contained in an aerosol droplet when the solvent evaporates limits the interest of the first solution even if the functionalization of the NPs avoid this drawback. However, this study allowed to develop simple solutions to control the proportion of NPs in the nanocomposite based on DBD frequency alternation[2-3]. Upstream formation of the NPs is a more promising solution first used in low pressure plasma. It allows the production and the spraying of isolated nanoparticles in a pulsed regime[4]. This concept of reactor-injector is under investigation at atmospheric pressure. Finally, the production of NPs directly in the plasma, during the thin film polymerization appears like a useful and easy to set up solution. Metal/polymer nanocomposite with non-aggregated NPs are made from a spray of metallic salt dissolved in a polymerisable solvent.
To conclude promising safe by design processes to produce controlled nanocomposite on large surfaces are under development and applied to various materials and properties.

[1] https://www.gdri-nanomateriaux.org/
[2] Brunet P. *et al*., Langmuir, 2018, 34 (5), pp 1865–1872
[3] Profili J. *et al* Journal of Applied Physics **120**, 053302 (2016); https://doi.org/10.1063/1.4959994

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