Fabrication of nanocomposite thin films by dip-coating: What impact do nanoparticles have on surface properties?

S. JEBALI[1*], M. VAYER[1] , M. ROULET[1], C. SINTUREL[1]

[1] *Interfaces, Confinement, Matériaux et Nanostructures (ICMN), CNRS-Université d'Orléans, UMR 7374, 1b, Rue de la Férollerie, C.S. 40059, 45071 Orléans Cedex 2, France*

*syrine.jebali@cnrs-orleans.fr

Keywords : Nanocomposite thin film, dip-coating, withdrawal speed, nanoparticles dispersion, surface properties

The design of composite materials, or even nanocomposite materials, assuming the filler has at least one dimension in the nanometric range, has exploded with the development of nanotechnologies. However, if many studies concern the fabrication of nanocomposites as macroscopic materials, fewer works deal with nanocomposites under the form of thin films. Furthermore, to the best of our knowledge, research about the conception of nanocomposite films in particular by dip-coating usually considers the deposition of the polymer solution and the colloidal suspensions of NPs as separated steps.[1] In fact, the simultaneous deposition of a combined polymer-NPs system has received less attention. In this context, our group works on the design of (nanocomposite) thin films using a one-step dip-coating process to engineer such coatings onto the surface of various materials, possibly having relatively complex geometries.[2] Thus, the preparation of nanocomposite coatings by dip-coating can be easily carried out if the polymer solution contains a colloidal dispersion of nanoparticles (NPs). However, many questions remain concerning the fabrication of nanocomposite thin films using this one-step procedure, in particular whether the presence of NPs has an impact on the well-known process and how do the withdrawal speed affects the NPs concentration onto/within the polymer film. Then, when the properties of nanocomposite thin films are concerned, the first question that comes is: how do the NPs modify the surface properties of the substrate. The investigation of such problematics has been performed through the deposition of a biocompatible water-soluble polymer, namely the polyvinylpyrrolidone (PVP) as a matrix to incorporate silica nanoparticles. An additional curing step of the obtained nanocomposite films has been also considered using UV-light irradiation to improve the stability of the polymeric matrix (figure 1).

The obtained results have shown that the control of the dip-coating process is undoubtedly relevant to tailor the properties of the final nanocomposite coating and subsequent applications by simply tuning the deposition parameters. For instance, the incorporated silica nanoparticles could be used as an efficient ground layer for subsequent post-modification that could be used for different applications, in particular for surface texturing and/or for energy surface lowering.

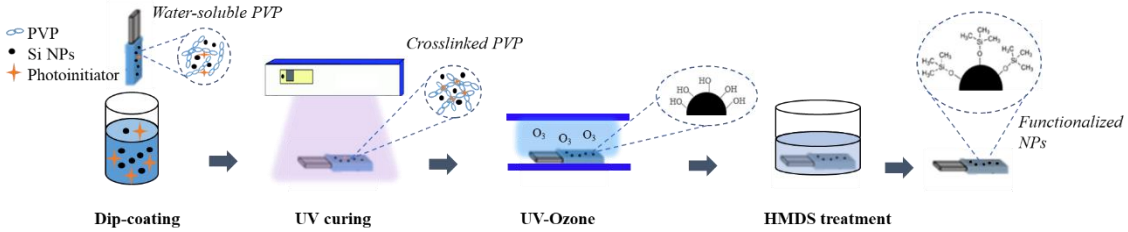

Figure 1 – Schematic of the nanocomposite thin film surface modification process

References

[1] A. Chavez-Valdez, A. Arizmendi-Morquecho, K.J. Moreno, J.A. Roether, J. Kaschta, A.R. Boccaccini Composites Part B: Engineering, **2014**, *Vol 67*, 256-261.

[2] C. Sinturel, M. Vayer, F. Mahut, F. Bonnier, I. Chourpa, E. Munnier Colloids and Surfaces A: Physicochemical and Engineering Aspects, **2021**, *Vol 608*, 125591.