BIOINSPIRED MULTIFUNCTIONAL COATINGS BY UV-NANOIMPRINT

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Nature can impart extraordinary properties to surfaces, such as super hydrophobicity or anti-reflectivity, through the synergistic work of hierarchical structures with nano and micro features and correct functional groups. [1-6] Two main approaches have been used to replicate nature's features: bottom-up self-assembly and top-down lithographic techniques. [7, 8] This work will focus on the use of UV-nanoimprint lithography (UV-NIL) to copy natural surfaces. Several papers have reported successful replication of natural surfaces, such as lotus leaf, rose petal, and moth eye, using liquid precursors and UVNIL, resulting in good hydrophobicity or anti-reflectivity properties. [9-13] These functional surfaces, however, are organic in nature and not specifically robust. A first objective of our work it thus to develop nanocomposite formulations using inorganic phases to create hard surfaces that are far more wear resistant than the polymer surfaces.[14] Multiple challenges associated with the addition of nanoparticles in UV-curing liquid resins which would compromise processability, such as a huge viscosity increase and light scattering will be addressed.[15] This work goes also beyond the examination of the hardness and wear resistance of the coating. It also delves into other properties, such as its effectiveness as a barrier against the diffusion of small molecules such as water or oxygen.

A further aim of this work is to implement the UV curable nanocomposite formulations for R2R processing of large surfaces with patterns replicated from nature. The focus will be on the impact of photocuring kinetics and formulation viscosity on the accuracy of lithographic details, as well as the development of a fluorine-free coating with self-cleaning and antireflective properties using R2R UVNIL processing.

This project received funding from the #horizoneurope20212027 programme under the Marie Skłodowska-Curie Doctoral Networks (MSCA-DN) grant agreement No 101073432

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Funded by the European Union

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