Tuning Surface Properties by Utilizing Polymer Nanocomposite Coatings

F. Gojda[1,2], **E. Petsi**[1,3], **M. Vlasiadi**[1,3], **A. Thomos**[1,3], **F. Krasanakis** [1], **M. Stylianakis**[1,4], **K. Chrissopoulou**[1,#,*] and **S. H. Anastasiadis**[1,3,*]

[1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Heraklion Crete, Greece

[2]Department of Physics, University of Crete, Heraklion Crete, Greece

[3]Department of Chemistry, University of Crete, Heraklion Crete, Greece

[4]Department of Nursing, Hellenic Mediterranean University, Heraklion Crete, Greece

Presenting author: K. Chrissopoulou, email: kiki@iesl.forth.gr

* Corresponding authors: K. Chrissopoulou, email: kiki@iesl.forth.gr & S. H. Anastasiadis, email: spiros@iesl.forth.gr

ABSTRACT

Superhydrophobic and water-repellent surfaces have attracted scientific interest in the last decades, due to their importance in numerous applications [1]. Their hierarchical surface roughness in combination with their chemical composition are the critical parameters that define the surface properties.

In this work, polymer nanocomposite coatings are developed in aqueous dispersions to be deposited onto either flexible polymer (polyethylene and polypropylene) or hard (stainless steel and glass) substrates. The coatings consist of low surface energy polymers (mixture of silanes/siloxanes or fluoropolymer) and nanoadditives of different geometries (SiO_2, Al_2O_3 and TiO_2 nanoparticles or MXene layered material) depending on the desired properties of the coated surface. In all cases the surface properties are investigated via contact angle (CA) and contact angle hysteresis (CAH) measurements, the surface morphology is imaged via scanning electron microscopy (SEM) and the surface roughness via profilometry and Atomic Force Microscopy (AFM). The effect of the nanoadditive type and content on the surface behaviour is evaluated.

Depending on the system utilized, the coated surfaces exhibit different properties [2,3]. The systems with the silanes/siloxanes mixture have higher water adhesion with enhanced mechanical properties, due to the crosslinked silicon resin that is formed on the substrate, after the deposition of the nanocoating. Furthermore, the system with the TiO_2 nanoparticles has low water adhesion with low hysteresis and roll off angles about 10°. On the other hand, the use of the fluoropolymer leads to coatings that exhibit superhydrophobic and water repellent behaviour. Furthermore, superoleophobic behaviour for various organic solvents was observed in certain cases, as well. These surfaces can be excellent candidates in applications that require self-cleaning capabilities, while coatings with TiO_2 nanoparticles and MXene can be also considered for antimicrobial applications.

REFERENCES

[1] S. H. Anastasiadis. 2013. *Langmuir,* **29**:9277 – 9290.
[2] F. Krasanakis, Th.-M. Chatzaki, K. Chrissopoulou and S. H. Anastasiadis. 2023. *Nanoscale*, **15**:6984 – 6998.
[3] F. Gojda, M. Loulakis, L. Papoutsakis, S. Tzortzakis, K. Chrissopoulou and S. H. Anastasiadis. 2022. *Langmuir,* **38**:4826 – 4838.