Study of the wettability of surfaces generated by aligned modified halloysite nanotubes through spray-coating

Michele Bonacina, Veronique Michaud, Yves Leterrier

Superhydrophobic surfaces are functional surfaces where a water droplet exhibits a contact angle greater than 150°, enabling it to potentially roll off easily. In nature, several plants' leaves, such as the lotus, exhibit this ability and are considered self-cleaning [1]. Numerous approaches have been attempted in the literature to replicate the intricate nano-micro morphology. However, several limitations have emerged, such as a lack of wear resistance and non-scalable production [2]. One way to overcome the issue of wear resistance is by incorporating hard nano-fillers [3].

Recently, clay has become very popular due to its low cost and excellent mechanical properties. Halloysite is a type of natural clay shaped like a tubule that can be used for mechanical reinforcement and to impart hydrophobicity to the surface[4]. Nanotubes can be oriented using an external force, such as the flow of compressed air in the spray coating technique. If the viscosity of the applied formulation is suitable, the relaxation time will be long enough to enable rapid curing and the fixation of a specific angle relative to the surface [5].

The project will focus on studying the influence of aligned halloysite nanoparticles on the morphology and wettability properties of a surface manufactured through spray coating and uv-curing.

Experimental tools:

- Material fabrication through spray-coating and uv-curing
- Chemical modification of halloysites
- Mechanical properties characterization (viscosity, etc.)
- Surface characterization (Optical Microscopy, SEM, Contact angle)

For more information: Michele Bonacina: michele.bonacina@epfl.ch

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

ESPERANTO
Enhancing the Sustainability of PhotopolymERs ANd phoToinduced prOcesses

Funded by the European Union

[1] H. Zhang, J. Gan, Y. Wu, and Z. Wu, “Biomimetic high water adhesion superhydrophobic surface via UV nanoimprint lithography,” *Applied Surface Science*, vol. 633, p. 157610, Oct. 2023, doi: 10.1016/j.apsusc.2023.157610.
[2] Q. Legrand, S. Benayoun, and S. Valette, “Biomimetic Approach for the Elaboration of Highly Hydrophobic Surfaces: Study of the Links between Morphology and Wettability,” *Biomimetics*, vol. 6, no. 2, Art. no. 2, 2021, doi: 10.3390/biomimetics6020038.
[3] P. Cully, F. Karasu, L. Müller, T. Jauzein, and Y. Leterrier, “Self-cleaning and wear-resistant polymer nanocomposite surfaces,” *Surface and Coatings Technology*, vol. 348, pp. 111–120, Aug. 2018, doi: 10.1016/j.surfcoat.2018.05.040.
[4] C. Ö. Diker, O. Duman, and S. Tunç, “Fabrication and characterization of superhydrophobic halloysite nanotube-based colored hybrid coatings with thermal, chemical, and environmental durability and self-cleaning ability on glass substrate by spray coating technique,” *Applied Clay Science*, vol. 244, p. 107109, Nov. 2023, doi: 10.1016/j.clay.2023.107109.
[5] K. Song, R. Polak, D. Chen, M. F. Rubner, R. E. Cohen, and K. A. Askar, “Spray-Coated Halloysite–Epoxy Composites: A Means To Create Mechanically Robust, Vertically Aligned Nanotube Composites,” *ACS Appl. Mater. Interfaces*, vol. 8, no. 31, pp. 20396–20406, Aug. 2016, doi: 10.1021/acsami.6b06174.