Towards Biomimetics of Superhydrophobic Water Strider Feet

Lukas Hageneder[a], Harald Plank[a], Karin Wewerka[a] and Ille C. Gebeshuber[b]

a Institute of Electron Microscopy, Graz University of Technology, Graz, Austria.
hageneder@student.tugraz.at, harald.plank@felmi-zfe.at, karin.wewerka@felmi-zfe.at

b Institute of Applied Physics, Technical University Vienna, Vienna, Austria.
gebeshuber@iap.tuwien.ac.at

This contribution summarizes first characterization results of superhydrophobic water strider feet with the vision to understand the interplay of morphology and chemistry to ultimately mimic such unique functionalities for future applications. The study started with chemical aspects to validate the likely existence of a wax layer. For that, separated legs were exposed to $CHCl_3$ under controlled conditions, followed by the chemical analyses of the solution. Fourier Transformed - Infrared Spectroscopy (FT-IR) and Liquid Chromatography - Mass Spectroscopy (LC-MS) could consistently confirm the expected wax layer as first element for the superhydrophobic functionality. In a second step, individual feet were studied via Environmental Scanning Electron Microscopy (ESEM), as representatively shown in Figure 1 by a strider foot overview (a) and a close-up of an individual hair (setae) in (b). For nanoscale studies, we prepared ultrathin cross sections via Ultramicrotomy (UM) and subjected them to Transmission Electron Microscopy (TEM), as representatively shown in the inset of (b). Together with Atomic Force Microscopy (AFM) studies on UM-prepared block-faces, we could confirm a partial wax coverage by a direct comparison of native and $CHCl_3$ treated feet. In a next step, we conducted ESEM-based, dynamic *in situ* studies, which directly revealed the hydrophobic H_2O condensation on native legs, as shown in Figure 1c. Currently, we work on a mechanical setup to access friction coefficients of differently treated legs, inspired by the Cavendish method. By that, we will be able to separate between morphology- and chemistry-related contributions to understand the origin of superhydrophobic water strider legs.

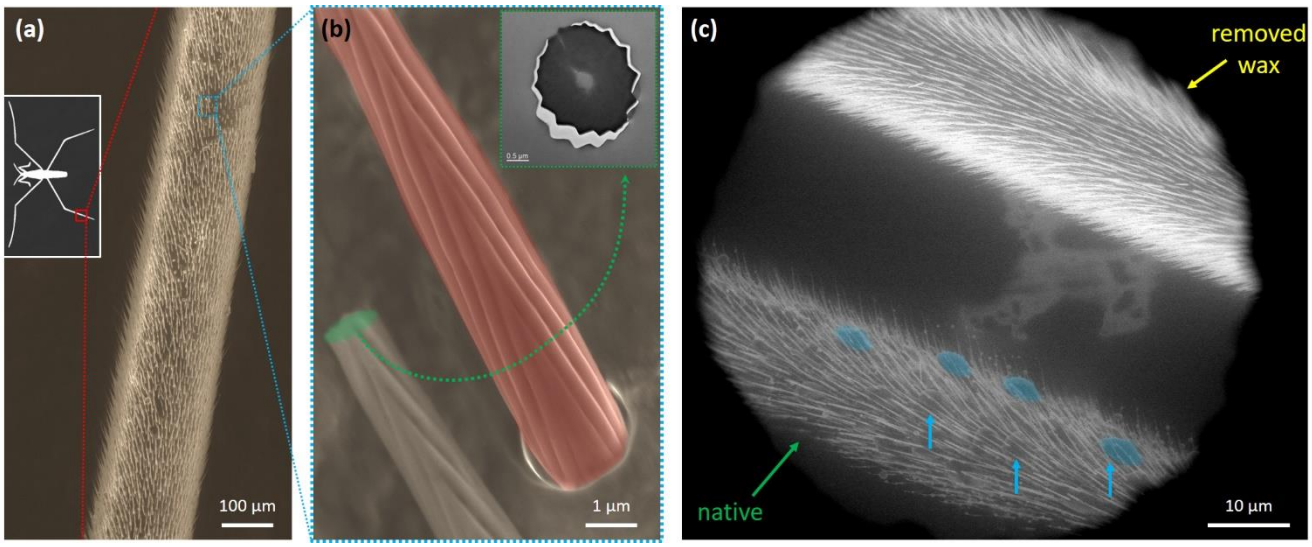

Figure 1: Electron Microscopy of superhydrophobic water strider legs. (a) shows a SEM overview image of a water strider leg, taken from the last part as indicated at the left. (b) shows a close-up of an individual hair (setae), which reveals their superstructure, as shaded red. The green ellipse conceptually shows where TEM cross-sections were taken after embedding with a TEM overview image as top right inset. (c) shows an ESEM image after dynamic H_2O wetting, where the upper part is a leg with removed wax, while the lower part is a native leg. As selectively indicated, wetting reveals the typical droplet formation for hydrophobic materials, which clearly confirms the impact of wax.