



**HAL**  
open science

## Supercooling droplets on environmentally-friendly biomimetic anti-icing surfaces

Florian Bas, Vincent Thomy, Yannick Coffinier, Maude Jimenez

### ► To cite this version:

Florian Bas, Vincent Thomy, Yannick Coffinier, Maude Jimenez. Supercooling droplets on environmentally-friendly biomimetic anti-icing surfaces. DROPLETS, Jul 2025, Liège (Belgique), Belgium. ⟨hal-05176171⟩

**HAL Id: hal-05176171**

**<https://hal.science/hal-05176171v1>**

Submitted on 22 Jul 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons CC BY 4.0 - Attribution - International License

## Supercooling droplets on environmentally-friendly biomimetic anti-icing surfaces.

Florian Bas<sup>1,2</sup>, Maude Jimenez<sup>2,3</sup>, Vincent Thomy<sup>1</sup>, Yannick Coffinier<sup>1</sup>

<sup>1</sup> Univ. Lille, CNRS, Univ. Polytechnique Hauts-de-France, UMR 8520 - IEMN – Institut d'Electronique de Microélectronique et de Nanotechnologie, F-59000 Lille, France

<sup>2</sup> Univ. Lille, CNRS, INRAE, Centrale Lille Institut, UMR 8207 - UMET - Unité Matériaux et Transformations, France

<sup>3</sup> Institut Universitaire de France (IUF), Rue Descartes, 75000 Paris

Author list: **BAS Florian**, JIMENEZ Maude, THOMY Vincent, COFFINIER Yannick

Ice formed from water in the environment causes significant consequences, including wasted energy, equipment failure and, in the worst case, accidents. To prevent these scenarios, superhydrophobic, low ice adhesion, and even anti-icing surfaces have been developed. These surface properties are obtained by using, in the large majority of cases, PFAS compounds, which, although they have shown good performance, are very polluting (#REACH regulation) [1]. In addition, surface texturing alone is not sufficient to completely prevent icing, as microdroplets can still penetrate the microstructure and form ice bridges. With a view to limiting the use of PFAS and obtaining stable properties we aim to design biomimetic non-wetting structured stainless-steel surfaces inspired by the *Nepenthes* pitcher plant, infused with an inert ecological lubricant, resulting in Slippery Liquid Infused Porous Surfaces (SLIPS) [2] with anti-icing properties (Figure 1a). The droplets should be able to freeze on the surfaces while having low adhesion to prevent ice from adhering to them. After a review of possible lubricants (ionic liquid, silicone oil, vegetable oil), it was decided to focus on fatty compounds. Our aim is to identify good correlations between freezing parameters and sample characteristics, such as surface structure size and shape, chemical functionalization and lubricant type, in order to develop a stable SLIPS that effectively retains the lubricant, even during the droplet freezing. (Figure 1b and Figure 1c).

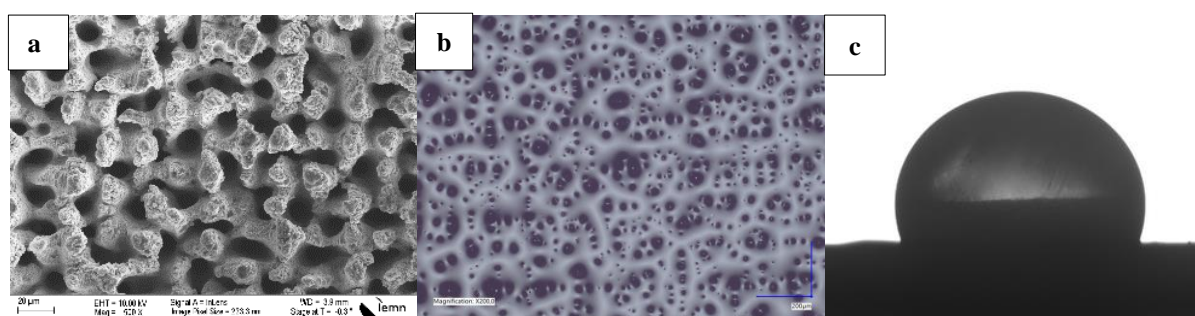


Figure 1. (a) Laser structured stainless steel surface, (b) Triglyceride-infused SLIPS before droplets deposition, (c) Freezing water droplet on a triglyceride-infused SLIPS.

[1] X. Wang, J. Huang, and Z. Guo, “Overview of the development of slippery surfaces: Lubricants from presence to absence,” *Advances in Colloid and Interface Science*, vol. 301, p. 102602, Mar. 2022, doi: 10.1016/j.cis.2022.102602.

[2] A.-S. Vaillard et al., “Highly stable fluorine-free slippery liquid infused surfaces,” *Surfaces and Interfaces*, vol. 42, p. 103296, Nov. 2023, doi: 10.1016/j.surfin.2023.103296.