Anti-icing properties of graphene on 15 nm ruthenium films grown by Thermal Laser Epitaxy

Espen Werdal Selfors
Amjad Al Taleb, Lena Majer, Sander Smink, Peter James Thomas, Naureen Akhtar, José María Castilla, Carlos Prieto, Daniel Farías, Wolfgang Braun, Bodil Holst
University of Bergen, Allégaten 55, Bergen, Norway
espen.selfors@uib.no

Ice formation has a strong impact on human activities in large parts of the world. Fundamental understanding of the icing properties of surfaces, with the aim of designing coatings and structures with anti-icing properties, is therefore an important research field. Optically transparent anti-icing solutions are needed for applications such as windshields on cars, sensor windows for long time monitoring and camera lenses. Graphene is particularly attractive in this context because of its transparency and robustness.
However, up till now only little work has been done on the anti-icing properties of graphene and functionalized graphene. Here we present a study of the anti-icing properties of a range of graphene samples deposited on ruthenium films of varying thickness grown on sapphire with chemical vapor deposition (200 nm) and using a novel coating technique: thermal laser epitaxy (15 nm). We show that the freezing onset for one of the graphene coatings grown with the novel method [1] is superior to previously published results on the freezing onset of graphene and fluorinated graphene.[2]
Our results support theory [3] which proposes that the freezing onset is similar for all types of surfaces, as long as they display pits within a given radius of curvature range, differing only when surfaces become very rough or very smooth relative to the critical radius for ice nucleation.

References

[1] Al Taleb, A. et al., Thin Solid Films, 758 (2022) 139449
[2] Akhtar, N. et al., Carbon, 141 (2019) 451-456
[3] Eberle, P. et al., Nanoscale, 6 (2014) 4874-4881

Figures

Figure 1: Water droplet on graphene, still liquid at -26.8°C.