Research topics for graduate students for 2024

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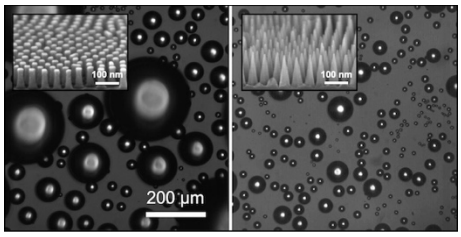
Acceptable course(s)

- Master's Degree
- Doctoral Degree



Research Topics

The main topic of research is the fabrication, characterization, and application of surfaces able to control fluids behavior at different scales, from confined flow inside nanochannels [1] to condensation, icing and drop behavior tailored by surface micro/nanostructures [2,3]. Applications range from freshwater production to functional surfaces with anticondensation or anti-icing properties. Following are a few research topics.

1. Water and ions transport inside 2D nanochannels

The transport of liquid and ions in nanochannels made of 2D materials strongly depends on the atomic nature of the confining walls [1] (*e.g.* graphene, hBN). The van der Waals assembly of 2D materials allows to control layer-by-layer the atomic properties of a surface [1] (*e.g.* conductive graphene, insulating hBN). One research subject is to fabricate nanochannels with controlled electrical properties and to understand how it affects water and ions at the interface using electrical measurements and non-linear optical techniques (*e.g.* Sum-Frequency Generation [4]).

2. Anti-icing properties of nanostructured materials

Hydrophobic nanostructures are known not only to repel water and condensation [2,3] but also to decrease ice adhesion [5]. The mechanism responsible for the adhesion reduction and how it is related to the cooling dynamics and structure size need to be understood. The results will be used to design anti-icing surfaces.

3. Hot liquid resistance of superoleophobic surfaces

Covering a surfaces with hydrophobic nanopillars allows to efficiently repel hot water [2,3]. Using 're-entrant' structures, low surface tension liquids such as oils or solvent can also be repelled [6]. However, the resistance of these superoleophobic surfaces to hot liquids remains to be explored. The design of hot liquid repellent superoleophobic surfaces will be challenged.

Articles Related to Research Topics

[1] T. Mouterde *et al. Nature*, **567**, 87–90, (2019). [DOI:10.1038/s41586-019-0961-5]

[2] T. Mouterde *et al. Nature Mater*, **16**, 658–663, (2017). [DOI:10.1038/nmat4868]

[3] T. Mouterde *et al. Nat Commun*, **10**, 1410, (2019). [DOI:10.1038/s41467-019-09456-8]

[4] S. Nihonyanagi *et al. Chemical Reviews*, **117**, 10665-10693, (2017). [DOI: 10.1021/acs.chemrev.6b00728]

[5] S. Bengaluru *et al. ACS Appl. Mater. Interfaces*, **8**, 12583-12587, (2016). [DOI:10.1021/acsami.6b01133]

[6] A. Tuteja *et al*. *Science*, **318**, 1618-1622, (2007). [DOI:10.1126/science.1148326]

Lab. Web page: http://www.mouterde-lab.com