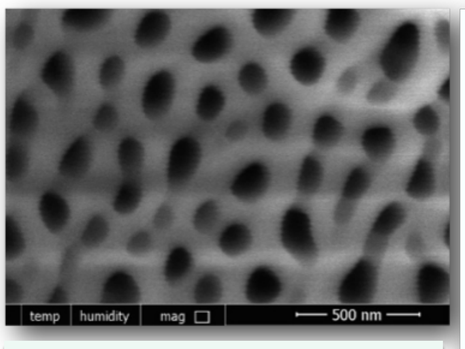
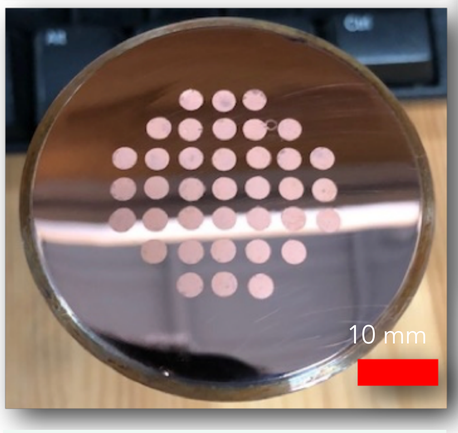
INTERPHASE TRANSPORT RESEARCH LABORATORY

Our mission The Interphase Transport Research (ITR) Laboratory is engaged in cutting-edge research in basic and applied studies of interfacial heat and mass transport phenomena. The research is of critical significance to the development of next-generation thermofluidic devices used for efficient and reliable thermal management of high-power-density applications ranging from computer chips to nuclear reactors. Through innovative research and technology development, we at the ITR strive to advance and broaden our current understanding of the fundamental physics involved in the multiphase multiscale phase-change processes of boiling and condensation. We believe that technological innovations derived under a sound theoretical framework can help create paradigm-shifting cooling strategies and ultimately improve energy utilization in industrial heat dissipation, which is integral to achieving the goal of a sustainable carbon-free future

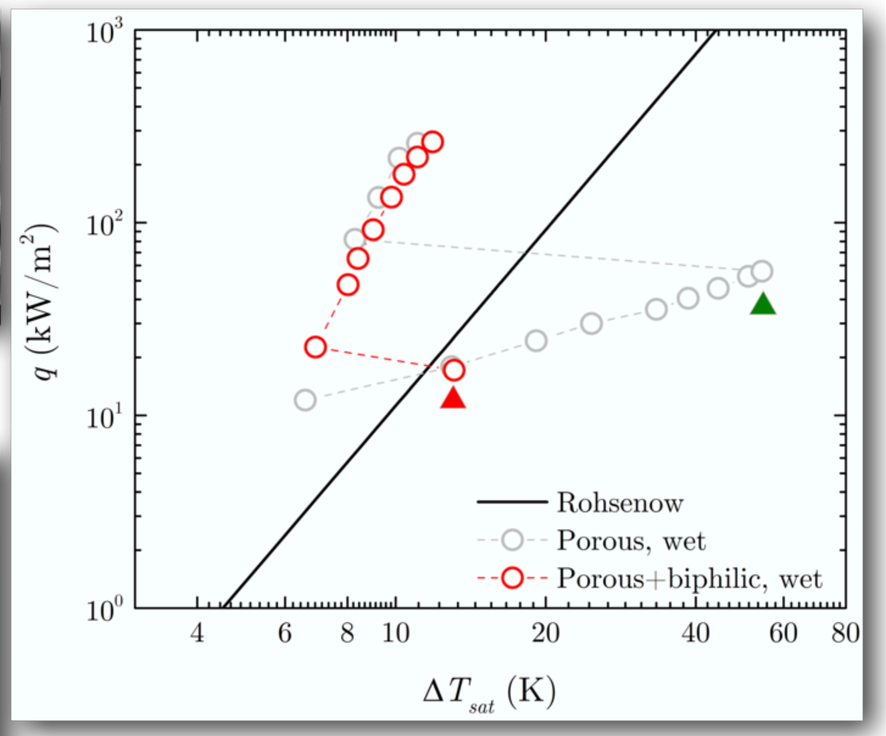
Boiling



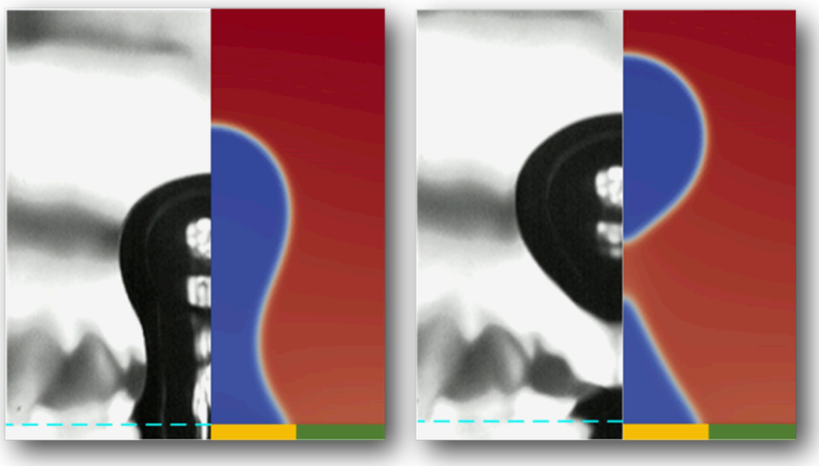
Surface wettability modified by amphi-phobic polymeric coatings



Porous surface structures deposited by phosphoric-acid anodization



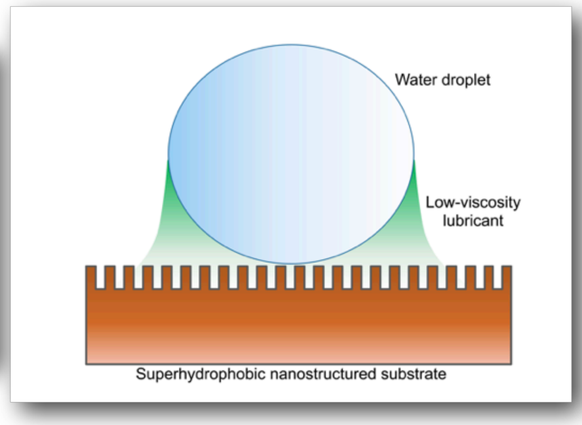
Combination of microporous surface texture and patterned biphilicity can lead to substantially reduced boiling threshold in addition to remarkable heat transfer enhancement

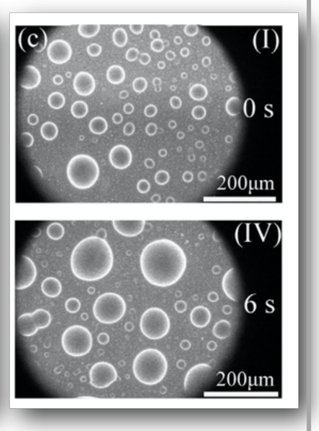


Complex interactions of triple-phase contact line and bubble growth dynamics on a heterogeneous surface captured by diffuse-interface modeling based on the van-der-Waals phase-field theory

Condensation

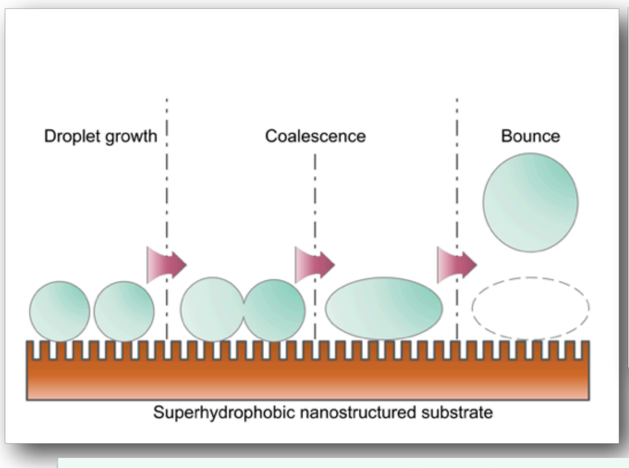
[www.flickr.com]

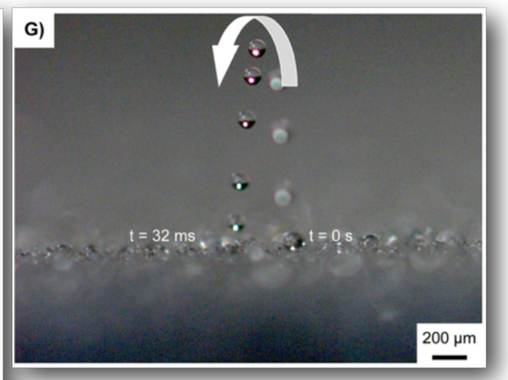




Rolling droplet on a bio-inspired slippery, liquid-infused porous surfaces (SLIPS)

Drop motion during the condensation process can be significantly facilitated by infusing a water immiscible liquid into a surface chemically functionalized to develop strong water repellency, which forms a stable, ultrasmooth lubricant overlays surrounding the droplet



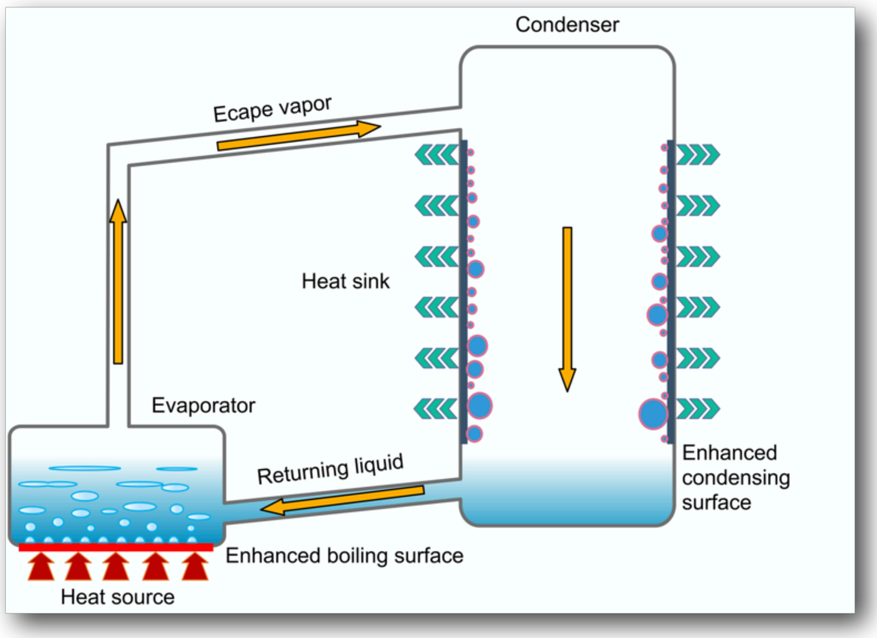


[ACS Nano, 11 (2017), 8499-8510]

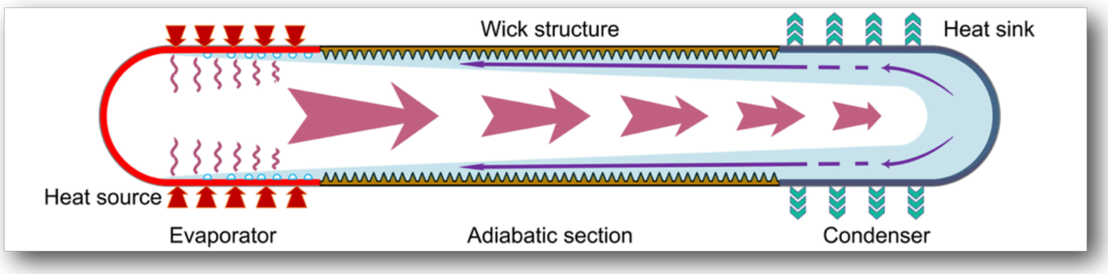
Jumping droplet cooling effect of a nanostructured superhydrophobic surface

Condensation can be enhanced by spontaneous Cassie-style droplet jumping from a nanotextured water-repellent surface

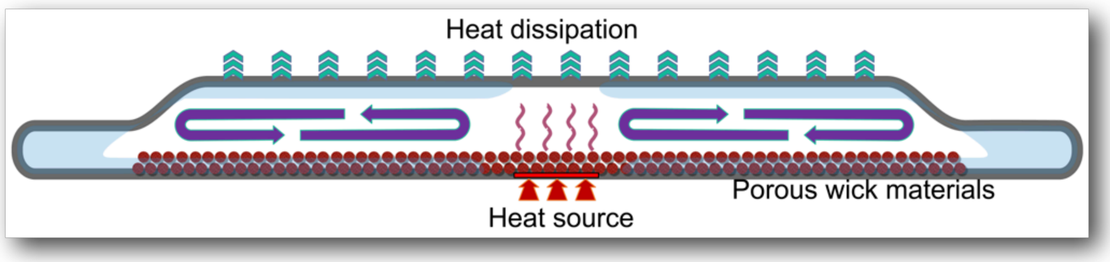
Two-phse heat trasnfer devices



Gravity-driven closed loop thermosyphon



Omnidirectional capillarity-driven heat pipe



Ultra-slim high-power vapor chamber cooling module

With the aim of providing industrial solutions to the thermal management challenge in microelectronic cooling, we focus on research and development of state-of-the-art thermofluidic devices that employ novel technologies of surface engineering and fabrication

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