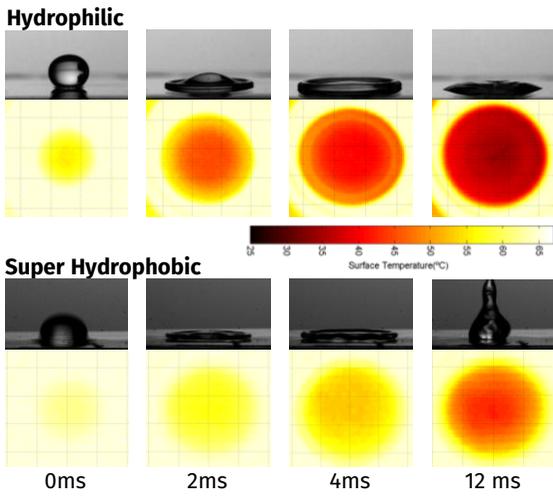


# Bioinspired Surfaces for two-phase heat transfer applications

## Abstract

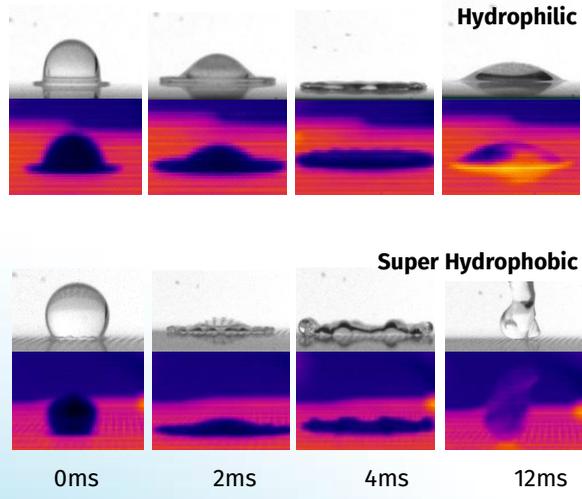
This project uses biomimetic and bioinspired design, mainly inspired in petals and plant leaves, to develop functional surfaces enhancing heat and mass transfer for industrial applications, e.g. cooling systems. State-of-the-art techniques (from laser etching to chemical coatings) were developed and used to devise micro and nanostructured surfaces, depicting extreme wetting properties (from superhydrophilic to superhydrophobic). Particular emphasis was given to the surfaces improving pool boiling heat transfer.

### Droplet Cooling (Bottom view)



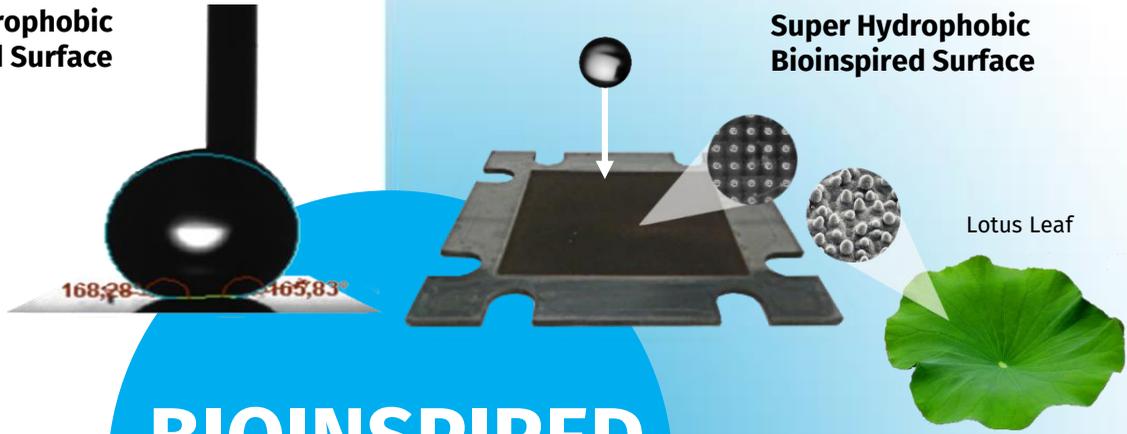
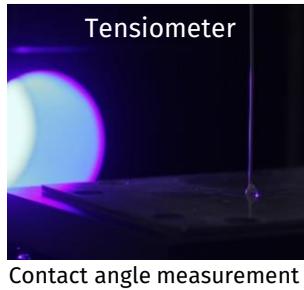
Super Hydrophobic surfaces are less effective in droplet cooling

### Droplet Cooling (Side view)



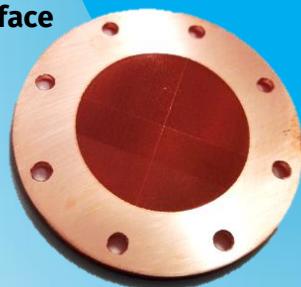
HIGH SPEED IMAGING + IR THERMOGRAPHY

### Super Hydrophobic Coated Surface

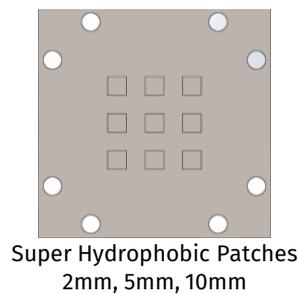


## BIOINSPIRED SURFACES

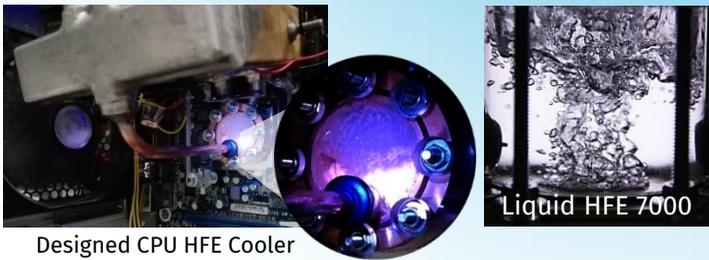
### Bioinspired Structured Surface



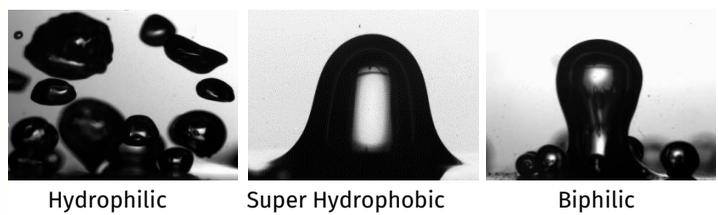
### Structured Biphilic Surface



### Two-phase Cooling Application



### Water Pool Boiling

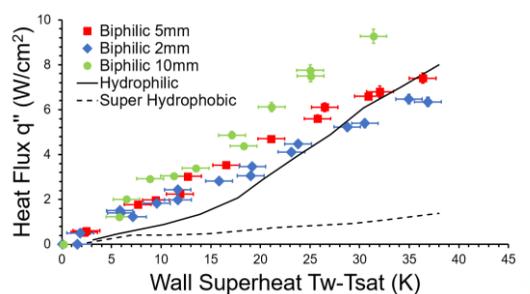


### Test on i7 CPU at 100% load (3.40GHz)

Fan Cooler		HFE Cooler	
Item	Maximum	Item	Maximum
<b>Temperatures</b>			
CPU	85	CPU	61
CPU Core #1	82	CPU Core #1	58
CPU Core #2	88	CPU Core #2	62
CPU Core #3	85	CPU Core #3	60
CPU Core #4	82	CPU Core #4	58

Optimized Bioinspired Surfaces in two-phase cooling systems, show improved heat removal

### Pool Boiling Curves



## Publications

- "Application of Bioinspired Super hydrophobic Surfaces in Two-phase Heat Transfer Experiments." Journal of Bionic Engineering 14,3 (2017): 506-519.
- "Sensible heat transfer during droplet cooling: Experimental and Numerical analysis." Energies (2017), 10,790;
- "Effect of extreme wetting scenarios on pool boiling conditions." Applied Thermal Engineering (2017), 115
- "2 Phase Microprocessor Cooling System with Controlled Pool Boiling of Dielectrics over Micro-and-Nano Structured Integrated Heat Spreaders." Proc of the IEEE Itherm (2016), pp. 378-387
- "Bubble dynamics and heat transfer for pool boiling on hydrophilic, super hydrophobic and biphilic surfaces." Journal of Physics: Conf. Series (2016), 745(3):032132

## Acknowledgements:

