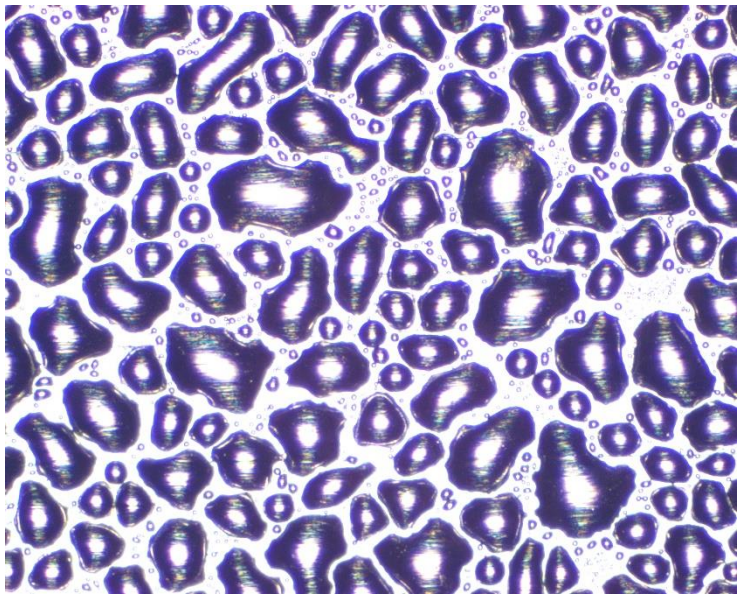
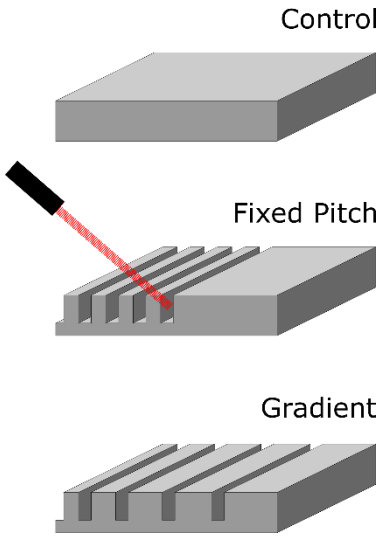
Condensation-frosting Investigation on Coating-free Topographic Wetting Gradients for Heat Transfer Applications





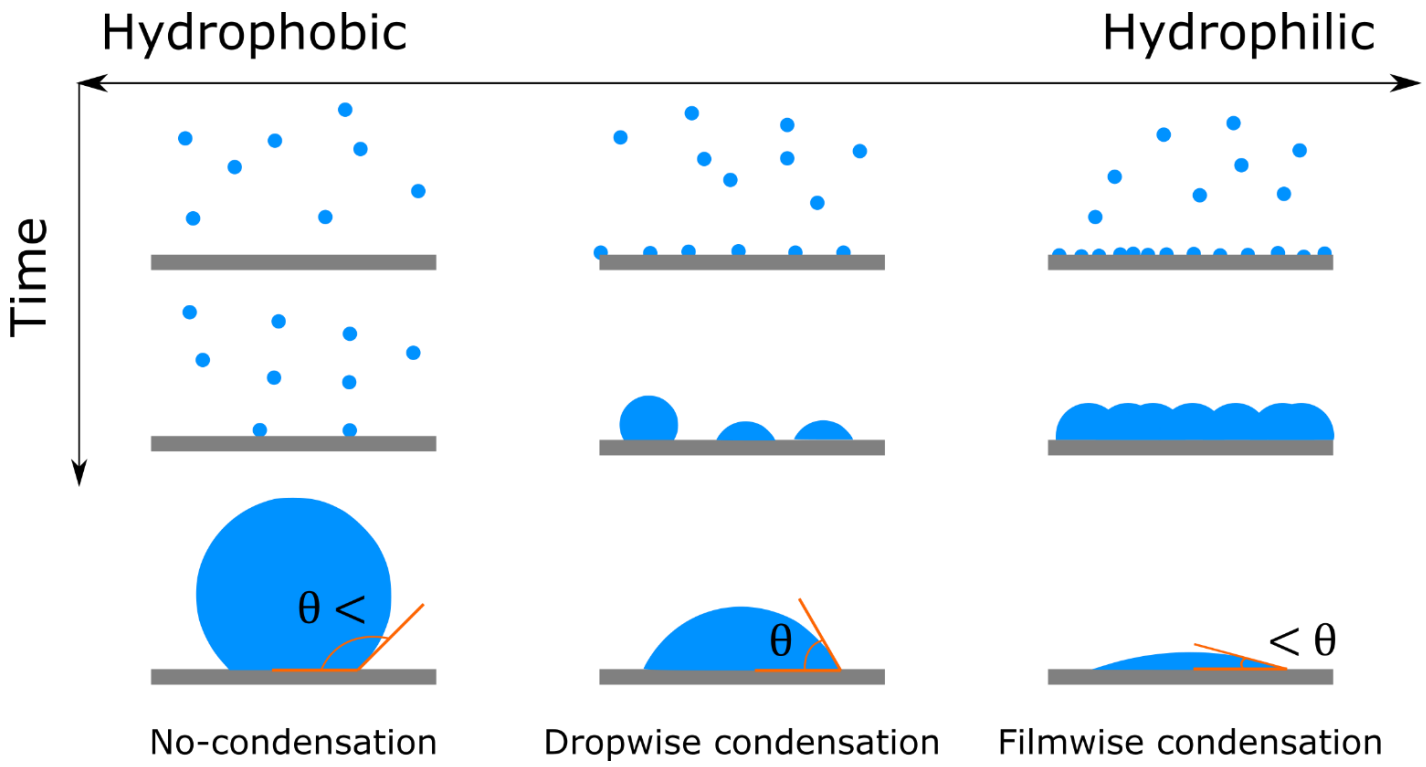
Chris Hughes[1,2], Sam Lowrey[1,2], Richard Blaikie[1,2], Zhifa Sun[1] & Andrew Sommers[3]

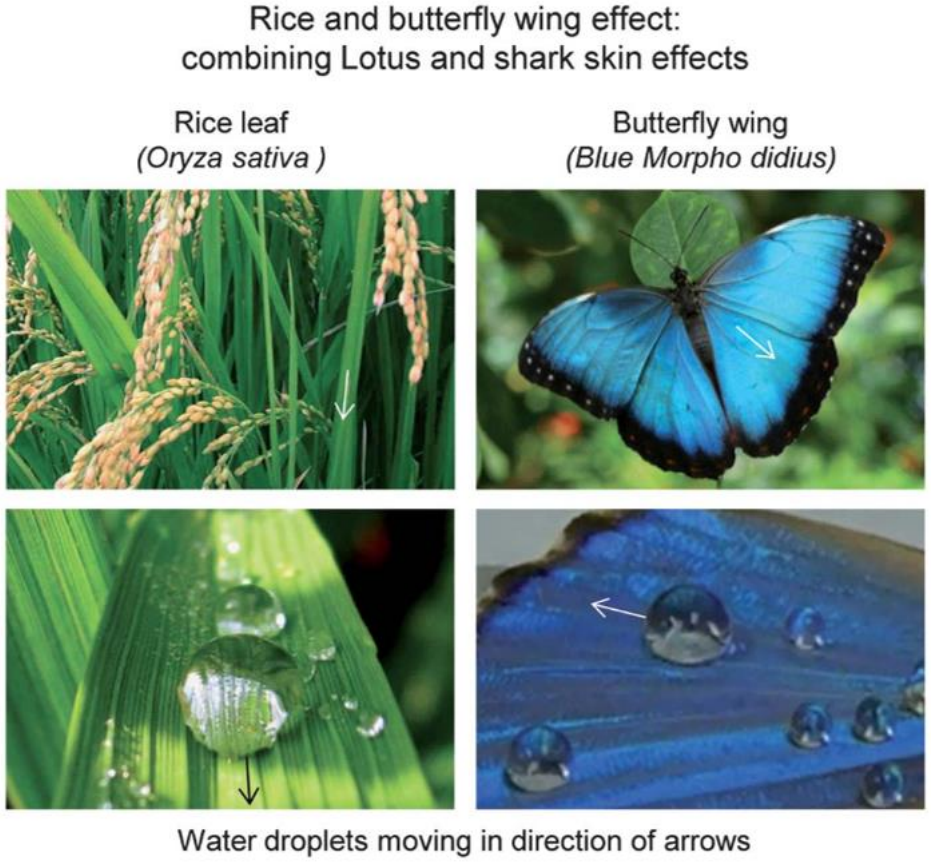
[1] Department of Physics, University of Otago, New Zealand

[2] The MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand

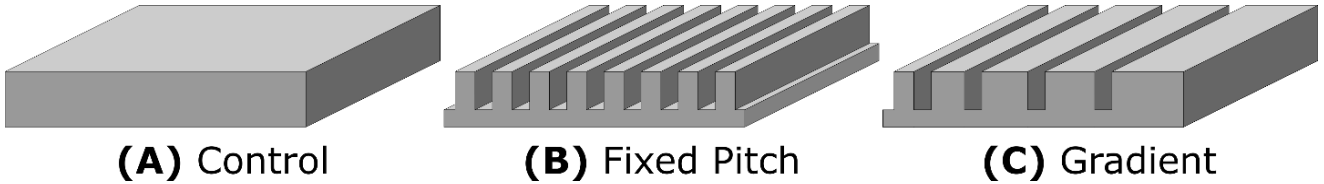
[3] Department of Mechanical & Manufacturing Engineering, Miami University, Ohio, USA

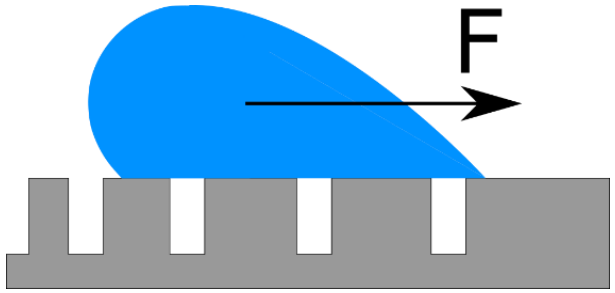
Background

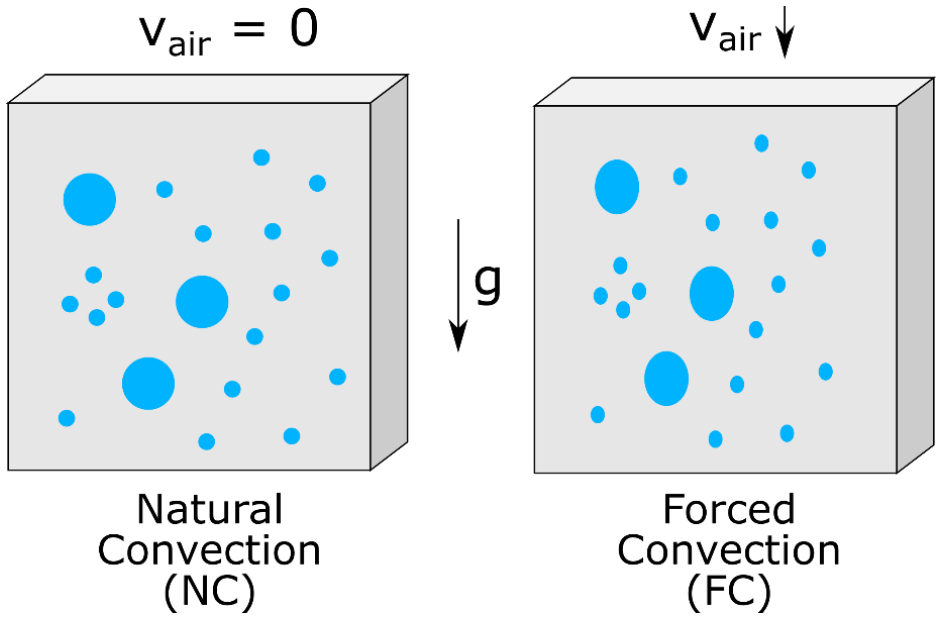

Hydrophobic
Hydrophilic
Time
θ <
θ
< θ
No-condensation
Dropwise condensation
Filmwise condensation


Rice and butterfly wing effect:
combining Lotus and shark skin effects
Rice leaf
(Oryza sativa)
Butterfly wing
(Blue Morpho didius)
Water droplets moving in direction of arrows

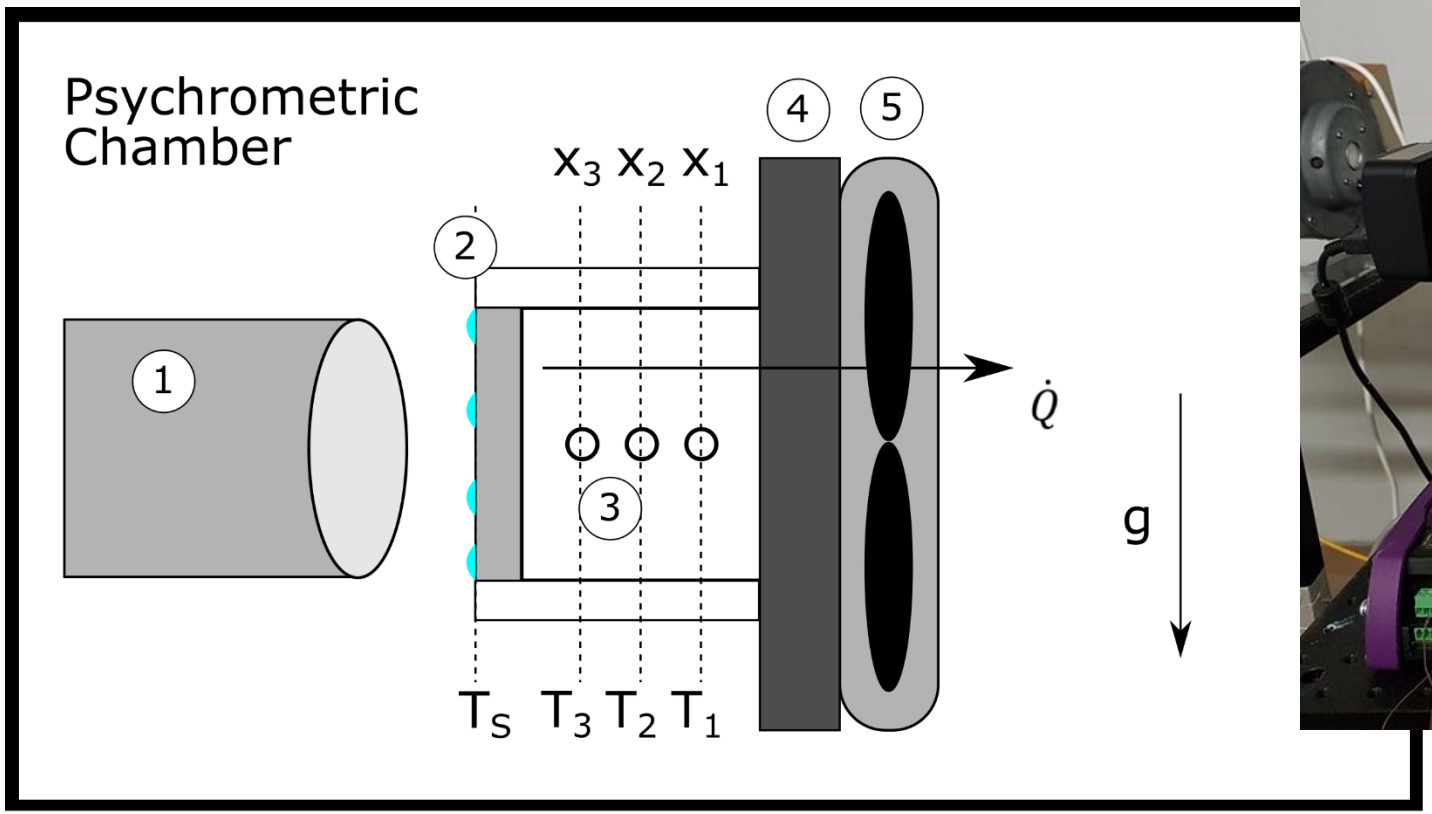
Objectives


(A) Control
(B) Fixed Pitch
(C) Gradient


F

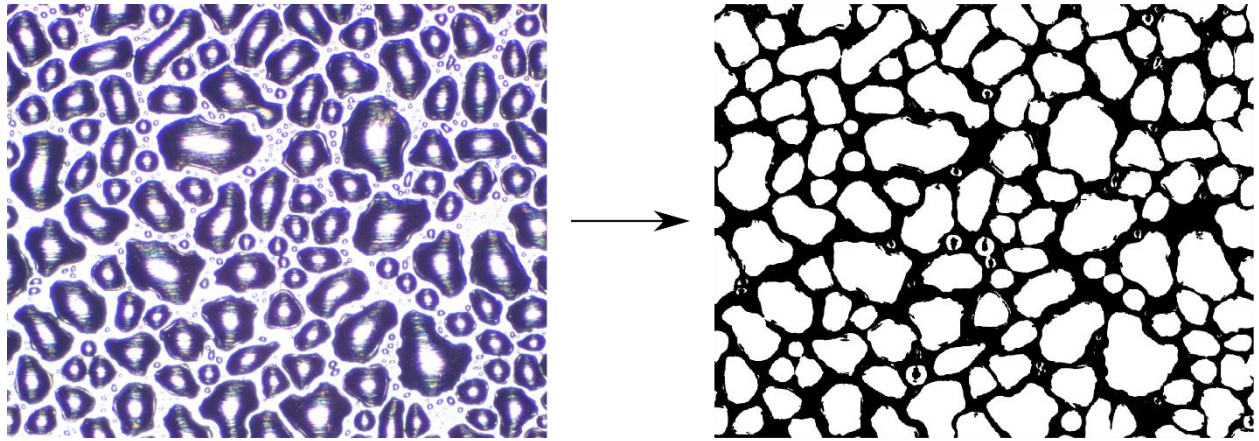

$v_{air} = 0$
v_{air}
g
Natural Convection (NC)
Forced Convection (FC)

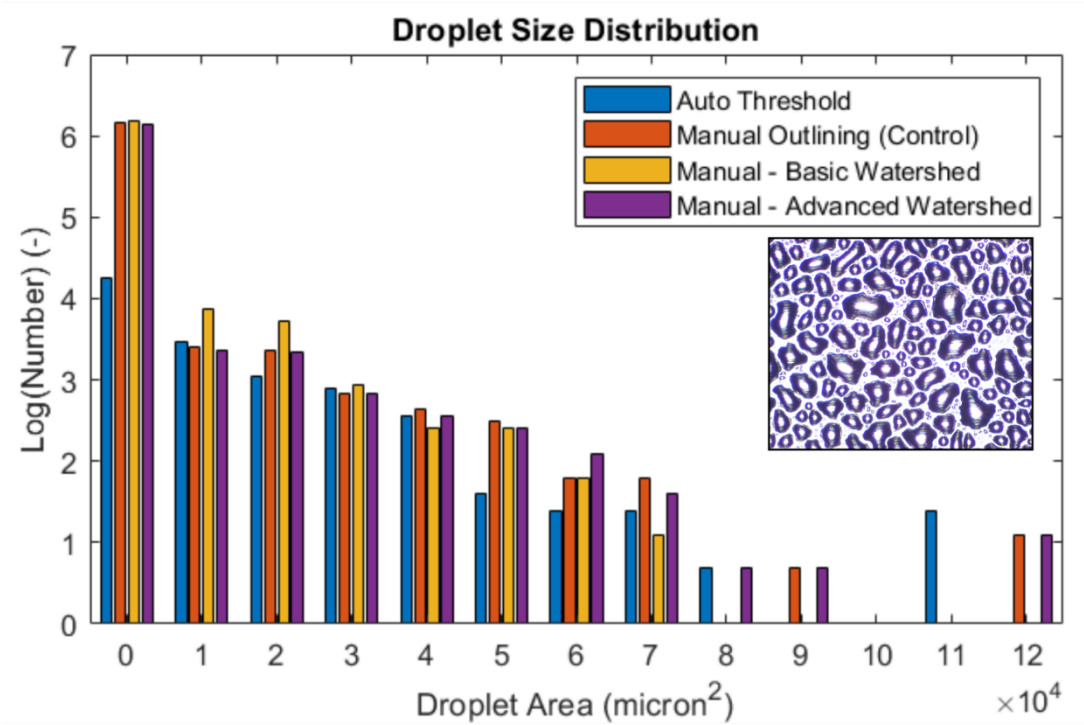
Natural Convection (NC) System



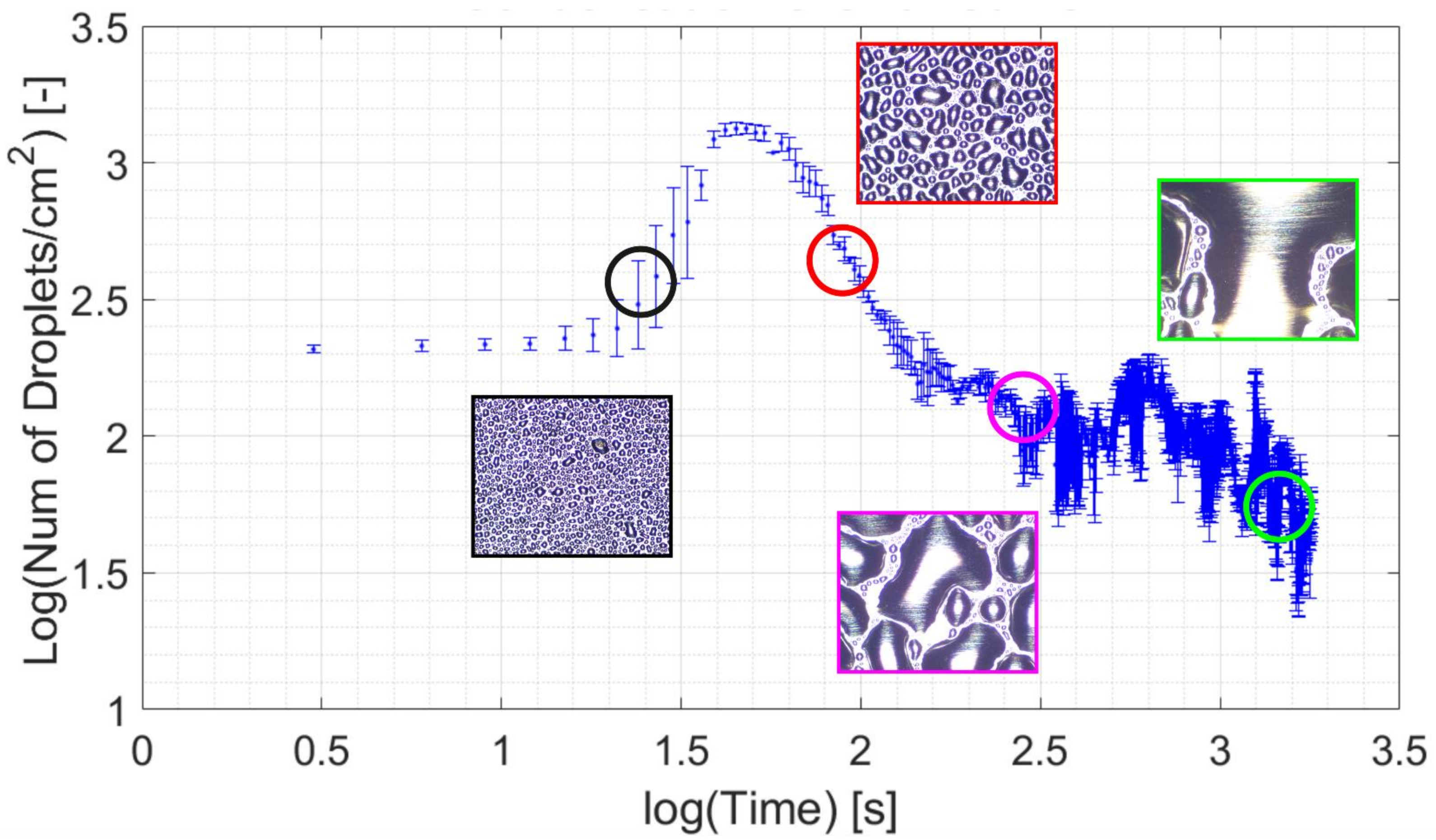
1 Objective Lens 2 Sample 3 Thermistor Array 4 Cooling Block 5 Peltier

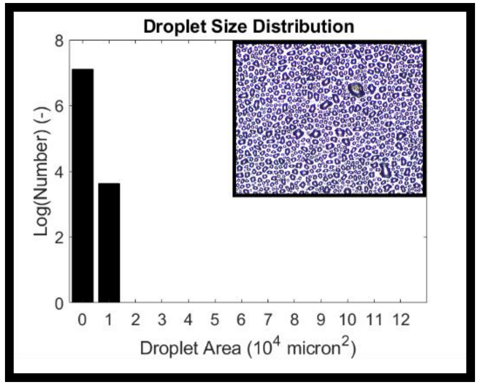
Image Processing Algorithm

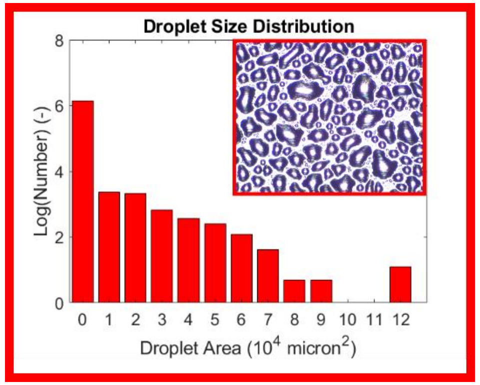


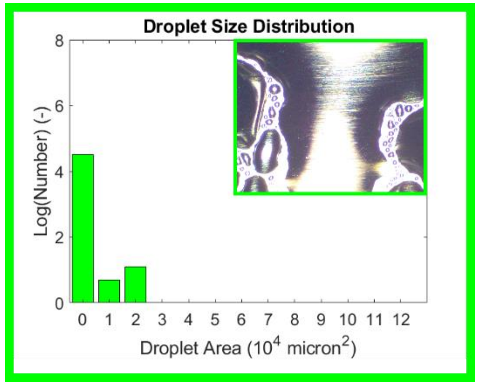


Condensation Growth Curves



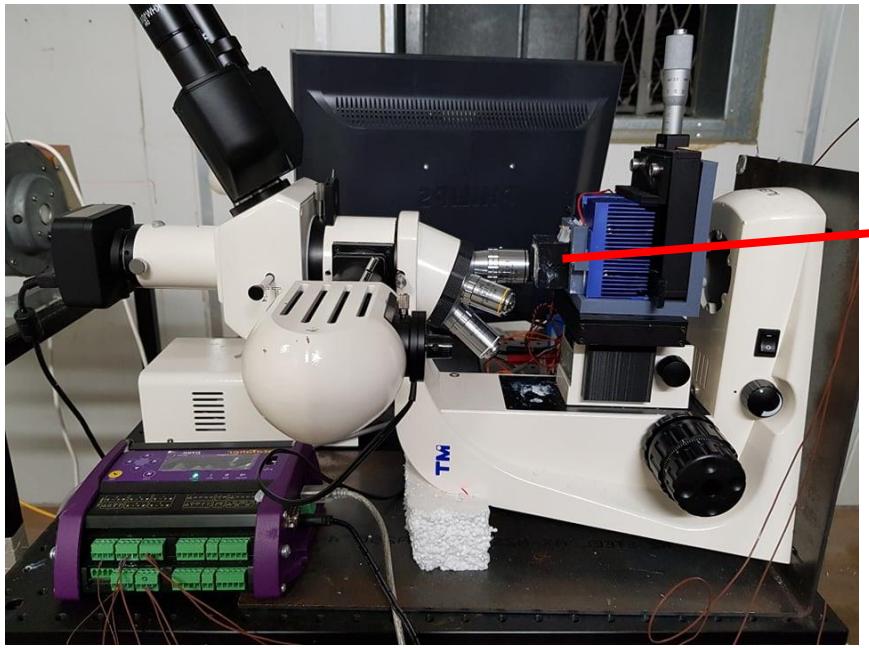


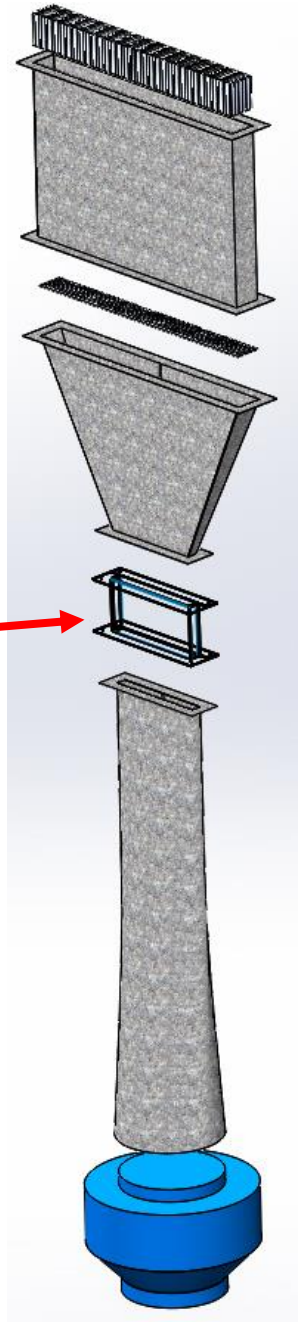




UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Forced Convection (FC) System - Wind Tunnel Design





Further Work

- NC & FC system – remaining image capture
- Airflow profile of wind tunnel
- Develop measurement method for **frost wavefront velocity**.
- **Heat transfer coefficients**