THE EFFECT OF RELATIVE HUMIDITY ON DROPWISE CONDENSATION DYNAMICS

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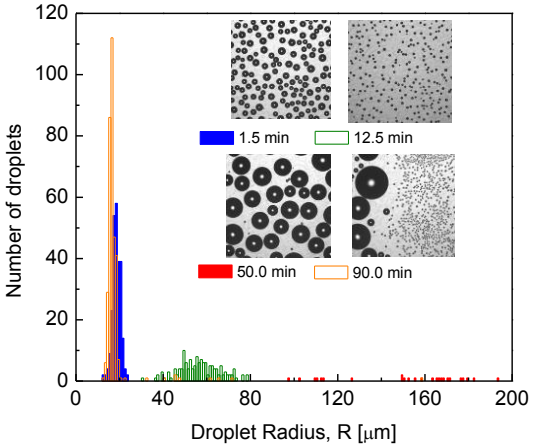
Objective

Investigate the roles of environmental factors and surface morphology/chemistry on dropwise condensation of atmospheric water vapor in order to understand how those factors relate to single droplet growth characteristics and how they affect overall condensation rates.

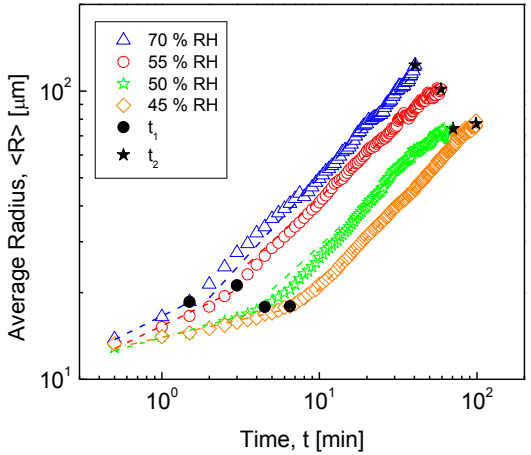
Approach

- Develop an experimental facility that allows the control environmental conditions during condensation of humid air in a cooled substrate
- Perform dropwise condensation experiments at different relative humidity conditions
- Modeling temporal evolution of single droplet and droplet distribution and compare it with experimental results

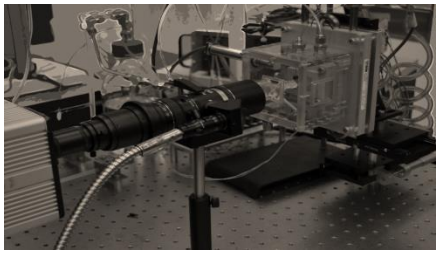
Results



(Top) Histogram of number of droplets at a given size at t = 1.5, 12.5, 50, and 90 min. Inset images show condensed droplets on the substrate.



(Top) Average radius versus time at ΔT_{sub} = 15 °C and 70%, 55%, 50%, and 45% relative humidity.



(left) Test facility

Impact

A better understanding of the time evolution of dropwise condensation under different environmental conditions has the potential to lead to the improvement of the design of industrial applications that involve condensation under extreme environmental conditions (i.e., low relative humidity)

Selected Publications

- J. E. Castillo, J. A. Weibel, and S. V. Garimella, *International Journal of Heat and Mass Transfer*, vol. 80, pp. 759–766, 2015.

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