Electrical Actuation of Droplets for Microelectronics Cooling

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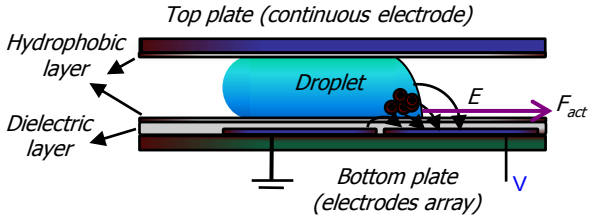
Objective

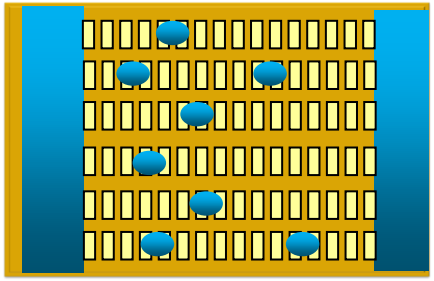
Develop technologies enabling electrical actuation and control of droplets for providing chip-integrated thermal management solutions



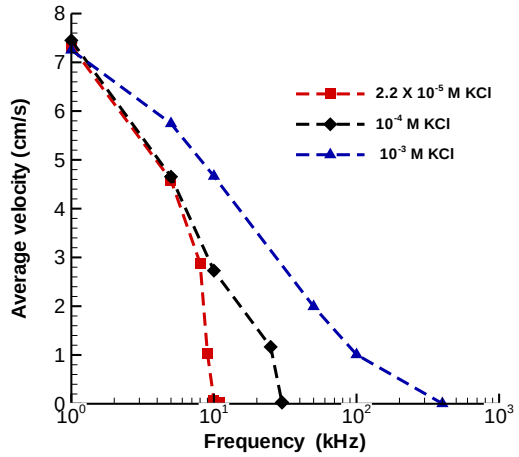
Approach

- Electrowetting based actuation of generic droplets using DC and AC actuation
- Fundamental study of droplet frequency response
- Experimental characterization of droplet flow and heat transfer
- Electrically tunable thermal resistance switch through control of droplet states on artificially roughened surfaces

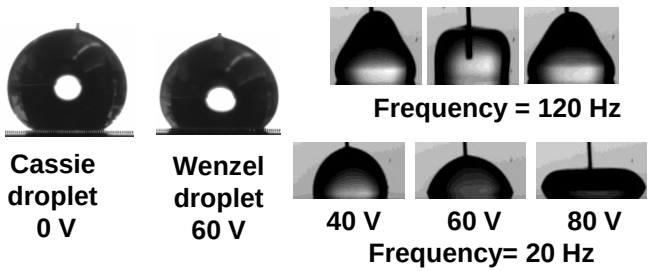
Futuristic Heat sink



Array of electrodes on backside of chip

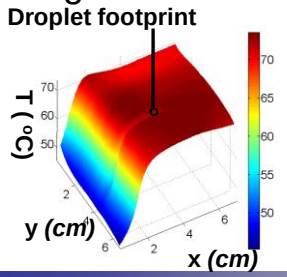


Experimentally obtained droplet velocity



Advantages

- Significantly enhanced control of flow at the microscale
- High liquid velocities at low voltages
- Noiseless, very low power consumption
- Solutions for chip-level and hot-spot thermal management



Temperature profile on lower wall of the plate (experimental)

Selected

- V. Bahadur and S. V. Garimella, *Langmuir*, Vol. 24 (15), 8338–8345, 2008.
- N. Kumari, V. Bahadur, and S. V. Garimella, *J. Micromechanics and Microengineering*, Vol. 18, 2008.
- N. Kumari, V. Bahadur, and S. V. Garimella, *J. Micromechanics and Microengineering*, Vol. 18, 2008.
- V. Bahadur and S. V. Garimella, *Langmuir* Vol. 23(9), pp. 4918-4924, 2007.
- V. Bahadur and S. V. Garimella, *J. Micromechanics and Microengineering* Vol. 16, pp. 1494-1503, 2006.

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