MS Seminar Talk - Speaker: Mohd Zahid (ME22S059)

Title: Study of humid air condensation on non-fluorinated wettability engineered surfaces.

Date/Time: 6th March 2025, 3 PM

Venue: Google Meet : https://meet.google.com/sea-mjiq-krc

Speaker: Mohd Zahid (ME22S059)

Biography of the Speaker: MS Research Scholar, Dept. of Mechanical Engineering

Affiliation of the Speaker:

Prof. Pallab Sinha Mahapatra - Guide, Prof. Arvind Pattamatta - Co-Guide

Prof. Chandramouli P - Chairperson,

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Abstract:

Atmospheric water vapour condensation is a prevalent phase change phenomenon in nature and is extensively used in various industrial applications, especially in atmospheric water harvesting, water purification, etc. Filmwise condensation is observed on high-energy surfaces like superhydrophilic (SHPL) surfaces. The surfaces with high contact-angle and low contact-angle hysteresis (CAH), like superhydrophobic (SHPB) surfaces, show dropwise condensation. These types of surfaces are generally fabricated using coatings of fluorinated compounds. Many toxic fluorinated compounds exhibit bioaccumulation in living organisms, raising serious environmental and health concerns. In this work, we fabricated various non-fluorinated surfaces (hydrophilic (HPL), SHPL, liquid infused surface (LIS) and superhydrophobic (SHPB)) for condensation experiments across a wide range of humidity ratio differences (7 − 24.9 g/kg of dry air). Higher water collection rates were consistently observed on LIS and SHPL surfaces under all environmental conditions, with enhancements of 13% and 5.6% for LIS and 9.5% and 4.3% for SHPL at humidity ratio differences of 12.5 and 24.9, respectively, indicating superior condensation performance. The detailed heat flux measurements explain the heat transfer mechanisms of the various fabricated surfaces. Heat flux sensors enable the measurement of the total heat fluxes during condensation processes for different situations, including sensible heat driven by the temperature gradient and condensation heat resulting from the phase change. Experiments were conducted on SHPL and LIS surfaces for more than 200 hours under continuously varying environmental conditions, confirming that both surfaces retained their condensation efficiency and surface characteristics. This research improves our knowledge of humid air condensation on sustainable, durable, and scalable nanoengineered surfaces, explicitly regarding the effect of distinct wettabilities.