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Phases of Water on Surfaces

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Abstract: Roughness-based superhydrophobic and superhydrophilic surfaces have been extensively studied for more than two decades. The early focus was to mimic nature, e.g. lotus leaves, to produce low-drag and/or self-cleaning surfaces. Through the past decade or more, the focus has also been on manipulating phases of (say) water on surfaces. Specific interest has been in applications such as boiling and condensation heat transfer, anti-icing/anti-frosting, water harvesting, among others. Through the years, we have organized the interrogation of this area based on equilibrium and non-equilibrium thermodynamic (and fluid dynamics) analyses corresponding to three pairs of phase changes (with two permutations each) – liquid-vapor, solid-liquid, and vapor-solid. Using such analyses, three foundational questions will be addressed in this talk: 1. How to eliminate Leidenfrost (vapor) film collapse and thus entirely change the boiling curve? 2. What non-dimensional number fundamentally characterizes Leidenfrost (vapor) film collapse in boiling heat transfer (and liquid-film collapse in condensation heat transfer)? 3. What is the interface temperature during “far” from equilibrium phase change?

Bio: Neelesh Patankar received his BS (B.Tech.) in Mechanical Engineering from the Indian Institute of Technology, Bombay (1993) and his doctorate in Mechanical Engineering from the University of Pennsylvania (1997). Following his Ph.D., he was a post-doctoral associate with Prof. Daniel D. Joseph at the University of Minnesota until 2000. He joined the Department of Mechanical Engineering at Northwestern University in 2000 where is currently a Professor. Neelesh is a Fellow of the American Physical Society. He has received the NSF CAREER award, the International Conference on Multiphase Flow's Junior Award, and has been selected to the Defense Science Study Group. Neelesh has been on the Editorial Boards of the Journal of Computational Physics, ASME Journal of Fluids Engineering, and Scientific Reports. He has also received several university-wide teaching awards at Northwestern University including Charles Deering McCormick Teaching Professorship.