CHARACTERIZATION AND MANIPULATION OF MICRO/NANO-SCALE FLUID DYNAMICS, SURFACE WETTING, AND HEAT TRANSFER

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The talk will also be available on MS Teams through this link

Abstract: Nanotechnology offers groundbreaking applications in physical and natural sciences. My research focuses on nanoscale transport phenomena for the discovery of new mechanisms and functional nano- materials. In this talk, I will summarize my research on (i) micro/nano-scale liquid flows, (ii) micro/nano-scale surface wetting, and (iii) micro/nano-scale heat transfer. Specifically, we will focus on the physical mechanisms creating divergence from the conventional continuum behavior in liquid dynamics due to the scale effects. I will present the results of Molecular Dynamics simulations of capillary flows to describe boundary slip and local viscosity, while an active electric field driven control of these mechanisms will be described. An electric field actuated nano-pump concept will be introduced for desalinization applications with nanoporous membranes. I will also describe the ionic current and conductance as a function of electroviscous, viscoelectric, and slip effects by resolving the Electric Double Layer with surface complexation models. Second, we will look into wetting control by micro/nano-scale surface patterning. We will discuss contact angle hysteresis through multiscale characterization of contact line pinning. Wetting behavior of chemically heterogeneous surfaces will be discussed and an extended Young's equation will be defined to re-visit Case-Baxter theory. I will also present my wetting conversion study of carbon nano-fiber reinforced epoxy composites using non- destructive laser ablation without fiber damage and electrospinning. Finally, we will look into thermal management problems as an active heat transfer control between graphene and water at nanoscale using interdigitated electrodes. Converting hydrophobic few-layer graphene to super-hydrophilic condition by electrowetting, I will present the enhanced heat removal by interface-localized liquid dielectrophoresis. Last, the Leidenfrost effects on evaporation of droplets will be presented at nanoscale.

Biography: Murat Barisik is the director of the Micro/Nano Engineering Group of IZTECH in Izmir, Turkey. He received his B.S. and M.S. in Mechanical Engineering from Middle East Technical University, Turkey. He obtained his Ph.D. (2012) in Aerospace Engineering from Old Dominion University, USA, where he graduated in the first rank and received the "Faculty Award in Aerospace Engineering". He received the "Brain Circulation Scheme" award from the European Union Marie-Curie program and relocated to Izmir Institute of Technology Mechanical Eng. Department. His research focuses on micro/nano-scale gas and liquid transport, heat transfer, surface wetting, electrokinetic phenomena, and functional nanomaterials/systems. He performs multiscale/ multiphysics modeling using computational fluid dynamics, computational chemistry, molecular dynamics and density functional theory, in addition to experiments on nanosecond laser ablation, electrospinning and mesoporous material characterizations. He is the author of 3 book chapters and 45 scientific papers in reputable international journals. He received the "Career Award" from The Scientific and Technological Research Council of Turkey and the "Outstanding Young Scientist Award" from the Turkish Academy of Sciences given by the President of Turkey.