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Young Researchers in Mechanical Engineering



Dynamic Microfluidic Architectures: From Precision Flow Control to Programmable Soft Material Fabrication

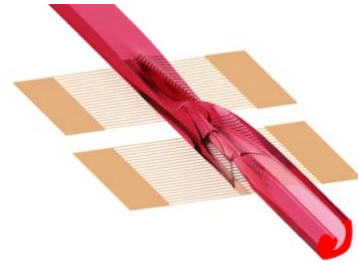
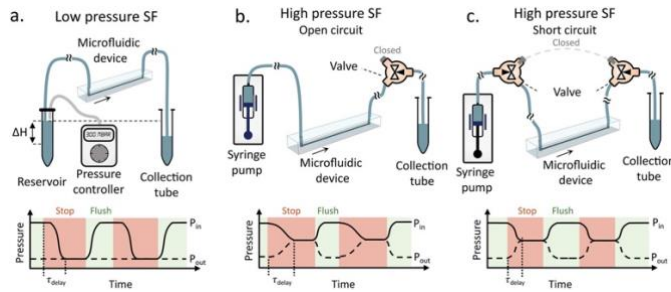
SPEAKER

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ABSTRACT

Microfluidics requires dynamic spatial and temporal fluid control to unlock applications like 3D bioprinting and advanced assays. This presentation addresses this need by introducing novel strategies for precise fluid manipulation. First, we analyze and achieve precise flow stoppage (residual velocity) by identifying and engineering solutions for fluidic circuit compliance (tubing and wall elasticity). Building on this foundational control, we introduce ActiSculpt, a modular platform for real-time, spatiotemporal sculpting of laminar co-flows. By integrating hydrodynamic stacking with surface acoustic wave (SAW) actuation, we dynamically deform fluid interfaces on demand, transforming fluid morphology into a tunable design parameter for programmable material fabrication. Finally, we translate this precision into a new compartmentalization technology: Lab-on-a-Particle (LoaP) and Lab-on-a-Fiber (LoaF). We detail the batch-manufacturing of shape-coded, multi-material particles that create uniform micro-compartments ('droplets') for scalable, multiplexed single-entity assays, demonstrating a highly sensitive diagnostic platform.



ABOUT THE SPEAKER

Mehmet Akif Şahin is a final-year Ph.D. Candidate at the Technical University of Munich (TUM). His research focuses on the intersection of dynamic microfluidics and advanced material fabrication. Leveraging his background in Mechanical Engineering (BSc from TOBB ETU and MSc from METU), his doctoral work centers on developing active microfluidic platforms—including Acoustofluidic systems like ActiSculpt—to achieve real-time spatiotemporal control over fluid streams. This includes pioneering work on modeling fluidic circuit compliance for ultra-precise flow control and advancing the Lab-on-a-Particle/Fiber technology for scalable, multiplexed diagnostics, printing. Mr. Şahin is a prolific young researcher with a strong publication record, including over 10 peer-reviewed articles in high-impact journals such as *Advanced Science*, *Small*, and *Ultrasonic Sonochemistry*.

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