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Utilizing chemo-mechanically functionalized oscillating fins to "catch and release" nanoparticles in binary flow YA LIU, University of Pittsburgh, YONGTING MA, Virginia Commonwealth University, AMITABH BHATTACHARYA, Indian Institute of Technology Bombay, OLGA KUKSENOK, University of Pittsburgh, XIMIN HE, JOANNA AIZENBERG, Harvard University, ANNA BALAZS, University of Pittsburgh — In biomimetics, designing an effective "catch and release" device for the selective removal of target species from the surrounding solution is critical for developing autonomous sensors and sorters. Using computational simulation, we model an array of oscillating fins that are tethered on the floor of a microchannel and immersed in a binary-fluid stream. During the oscillation, the fins with the specific chemical wetting reach the upper fluid when they are upright and are entirely within the lower stream when they are tilted. We introduce specific adhesive interactions between the fins and particulates in the solution and determine conditions where the oscillating fins can selectively bind ("catch") target nanoparticles within the upper fluid stream and then release these particles into the lower stream. We isolate the effects of chemical wetting on the fins (e.g., wetting contact angle between fins and fluid) and mechanical parameters (e.g., frequency of fins' oscillations) that lead to the efficient extraction of target species from the upper stream and placement into the lower fluid. Our understanding provides fundamental insights into the system's complex dynamics and mechanism for detection, separation, and purification of multi-component mixtures.

Ya Liu
University of Pittsburgh

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