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Invited Talk

Magnetomicrofluidics for Sorting Bioparticles

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Abstract: Single-cell arrays (SCAs) have important applications in the analysis of phenotypic heterogeneity, which is difficult or impossible to analyze in bulk cell culture or patient samples. However, existing systems lack the required combination of being adequately, programmable, flexible, and massive-scale to enable the study of cell behaviors and cell-cell interactions at the scales necessary to analyze extremely rare events. To advance the field, we have developed a novel, programmable, and massively-parallel SCA system which is based on the principles of computer circuits. By integrating these magnetic circuits with microfluidics channels, we have developed a platform that can organize a large number of single cells into an array in a controlled manner. Our magnetophoretic circuits use passive elements constructed in patterned magnetic thin films to move cells along programmed tracks with an external rotating magnetic field. These magnetophoretic circuits also employ active elements constructed in an overlaid pattern of microwires, to switch single cells between different tracks. By combining these elements, we have built a single cell array, which is capable of organizing a precise number of cells into individually addressable array sites, similar to how a random access memory (RAM) stores electronic data. Our programmable magnetic circuits allow both individual cells as well as single-cell pairs to be formed into large arrays and incubated on the chip for multiple days, enabling the long-term phenotypic analysis of rare cellular events. Single cells can also potentially be retrieved for downstream high-throughput genomic analysis.

Biography – After earning degrees in Electrical Engineering, Roozbeh Abedini Nassab received his Ph.D. degree in Mechanical Engineering and Materials Science from Duke University. He also became a fellow at Duke's Center for Biomolecular and Tissue Engineering (CBTE). His scientific works have been published in well-known high-impact journals including Nature Communications, Advanced Materials, and Advanced Functional Materials. Moreover, he has received several awards for presenting his works at various scientific conferences and for publishing them in scientific journals. He is also the editor and the director of writing/editing of several scientific journals. Currently, he is a Postdoctoral Associate in the Biomedical Engineering department at Cornell University. Roozbeh Abedini Nassab is interested in employing engineering techniques, microfabrication, and nanotechnology in developing novel tools and innovative methods to answer important questions in Biology and Medicine and to overcome challenges in diagnosis of human diseases.
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زمان: دوشنبه ۱ خرداد ماه، ساعت ۱۴ الی ۱۵

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