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Magnetophoretic circuits for digital cells on chip

CheolGi Kim
DGIST, Republic of Korea

The ability to analyze the cellular contents of individual microorganisms would significantly benefit our understanding of many mechanisms in the minute world of cell biology. Compared with flow cytometry, single cell arrays are promising multi-parameter tool for long term observation of biological processes by monitoring cells randomly deposited into micro-well arrays or locally trapped by hydrodynamic, electric or magnetic fields. However, these existing tools are frequently limited either by irreversibility in the placement of cells or lack of tools for efficient extraction of single cells, poor nutrient diffusion and temperature control, and the need for complex wiring and microfluidic patterns which prevent the highly parallel operations necessary for identifying extremely rare cells. In this context, we develop lithographically patterned magnetophoretic pathways which transport single cells reversibly (conductor) or irreversibly (diode) and can locally store single cells in an array of apartments (capacitor). The active devices consists of current lines that can locally switch the trajectory of single cells (transistor) and when combined with the passive elements can produce highly scalable systems that have general multiplexing properties with dramatically reduced wiring constraints that allows an efficient implementation of digital circuitry for single cells. This work provides fundamental tools that enable breakthroughs in the analysis of cell heterogeneity and provide new routes for genomics/proteomics, human reproduction and cancer research.

Biography

CheolGi Kim has completed his PhD from KAIST in Korea and Postdoctoral studies from NIST in USA. Now he is a Professor and Head of the department at DGIST. Prior to coming to DGIST, he has 24 years of research experience at KRISS in Korea, Sun Moon University in Korea, Tohoku University in Japan and Chungnam National University in Korea. He has trained number a of PhD students who have gone on to successful researchers in their own related research fields. His research interests skate the intersection between technology and competitive strategy. During his professional period, he published ~ 300 articles in research journals, and 15 national and 6 international patents. For his contribution to the scientific research, he was honored by many awards.

cgkim@dgist.ac.kr

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