Development of hybrid FACS-Coulter counter cytometry microfluidic chip

Jongho Joo, Honggu Chun, Taek Dong Chung and Hee Chan Kim

Seoul National University, University of North Carolina

Corresponding author: Hee Chan Kim, Department of Biomedical Engineering, Seoul Nation, , Seoul, Email: bluehayat@melab.snu.ac.kr, bluehayato@hotmail.com

Abstract

Introduction: We report a microchip system detecting particle size through impedance analysis while simultaneously detecting fluorescence signals (fig.1). Particle size analysis in microfluidics has been done using various methods such as Coulter counter methods and Laser induced fluoroscopy methods. However, Coulter counter method detects only the size of the passing particles, and therefore no fluorescence information can be acquired. Fluorescence information is used for analysis of cells and other biological particles. Laser induced fluoroscopy uses laser as the primary fluorescence induction and particle size analysis, but requires large and expensive induction and detection system, is difficult to implement onto a portable system, and the optical setup system is complicated. Microfluidic application of various fluorescence particle analysis is focused on the size reduction of the entire system, and therefore a method of detecting particle size with an electrical method while optical detection only applies to fluorescence detection is expected to greatly reduce the overall complexity and cost of the flow cytometry system.

Methods: Particle size analysis was done with a pair of Polyelectrolyte Gel Electrodes (PGE) using DC impedance analysis on a glass microchannel. The microfabricated PGEs, along with glass microchip frame, are transparent. Therefore, we have implemented a fluorescence induction circuit using a 470 nm Light-Emitting-Diode perpendicular to the optical detection setup. Fluorescent beads (480,520) of sizes 5, 10 & 15um in PBS solution were measured using the glass microchip setup.

Results: Fig.2 shows the result of detecting plain microbeads and fluorescent microbeads using the developed hybrid FACS-Coulter counter cytometry microfluidic chip. Upper peak corresponds to the impedance signal detected with the PGEs while the lower peak corresponds to the fluorescence signal detected with a photomultiplier tube. Distinct impedance signal difference between microbeads enables size recognition of the particles flowing through the microchannel while the fluorescence data shows the fluorescence on the beads passing through the detection region.

Discussion: In this study, particle size and fluorescence data in microchannel along with the mixture ratio of them were measured, enabling a novel method of implementing flow cytometry in a microfluidic system.