【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering Ⅰ)

Title of Project : Advanced Micro Fluidic Engineering and Its Applications for High Sensitive Quantitative Measurements of Biomolecules

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Research Area : Instrumentation Technology
Keyword : Measurement System , MEMS・NEMS, Micro Bio System

【Purpose and Background of the Research】

Micro fluidic engineering have been developed with Micro Electro Mechanical Systems: MEMS technologies and nanotechnologies. The purpose of our research is to obtain high sensitive quantitative measurements of biomolecules by applying advanced micro fluidic engineering. In order to achieve this purpose, we develop micro fluidic devices/systems including on demand functional tools for optical measurements. The key issues of our research are to establish on demand high sensitive optical measurement methods and to develop precisely controlled sample preparation technologies in micro meter scale channels of the micro fluidic devices/systems. The precise time and positional control of micro droplets of sample and reagent obtains maximum optical signals. (Fig.1)

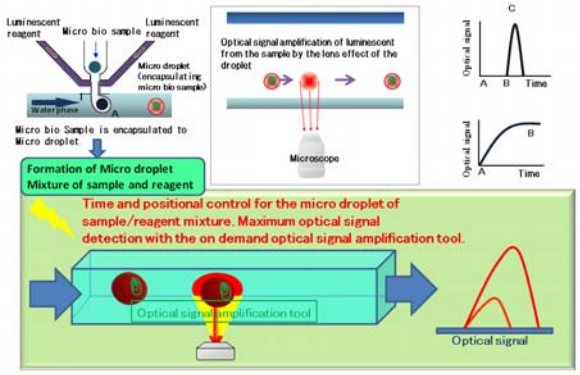

Fig.1: Principles of our research

【Research Methods】

To achieve high sensitive quantitative optical measurement we establish and integrate the following basic technologies. The fabrication and evaluation of functional micro fluidic devices and systems are also performed.

① Fabrication of high sensitive Optical Signal Amplification tools, e.g. ultra-flat glass surface, micro pillars, micro lens etc.
② Precise flow control technologies of specific three dimensional sheath flows and for ultra-fine droplet formation including nano/micro magnet beads.
③ Ultra-small volume sample preparation technologies to realize precise time controlled reaction for quantitative measurements.

【Expected Research Achievements and Scientific Significance】

The proposed micro fluidic engineering realizes precise time and position control of the ultra-small volume sample/reagent mixture in the micro channels. This is very important to obtain maximum signal at the optical detection point. Combination with on-demand Optical Signal Amplification tool makes remarkable improvements on sensitivity. The results of our researches will contribute on high sensitive quantitative analysis of a biological cell, a virus, an organelle, a DNA and a nano-particle. In the future, the advanced micro fluidic engineering enables functional on-site optical measurement to achieve efficient real-time analysis of ultra-small volume samples and to realize quantitative analysis of scarcity samples.

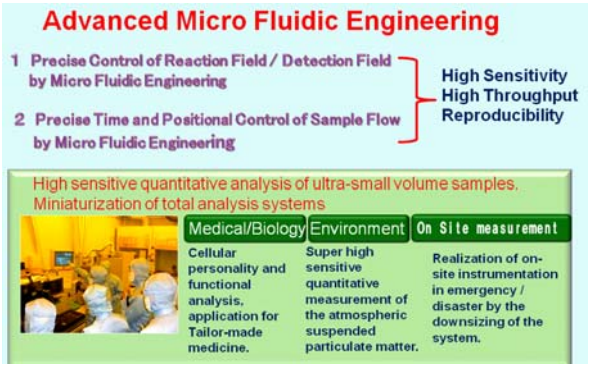

Fig.2: Expected contributions of our

【Publications Relevant to the Project】

1. K. Ozaki, H. Sugino, T. Funatsu, S. Shoji, et. al., "Microfluidic Cell Sorter with Flow Switching Triggered by a Sol-Gel Transition of a Thermo-Reversible Gelation Polymer", Sensors and Actuators B 150 (2010) pp.449-455
2. T. Arakawa, Y. Shirasaki, T. Funatsu, S. Shoji, et. al., "Rapid Multi-Reagents Exchange TIRFM Microfluidic System for Single Biomolecular Imaging", Sensors and Actuators B 128, June 2007 (2007) pp.218-225

【Term of Project】 FY2011-2015
【Budget Allocation】 166, 100 Thousand Yen
【Homepage Address and Other Contact Information】
http://www.shoji.comm.waseda.ac.jp/