

FY2012

JSPS Core-to-Core Program
-Strategic Research Networks-
Research Report

Project No.	20002
Research Theme	International Core Research Center for Micro/Nano Chemistry
Duration of Project	2010-2012
Core Institution in Japan	School of Engineering, The University of Tokyo

Implementing Organizations

Country	Japan
Core Institution	School of Engineering, The University of Tokyo
Co-Chair (name and title)	Prof. Takehiko Kitamori
Number of Cooperating Institutions	4
Cooperating Institutions	Kyoto University, Nagoya University, Waseda University, Japan Women's University

Country	Sweden
Core Institution	Uppsala University
Co-Chair (name and title)	Prof. Ulf Landegren
Number of Cooperating Institutions	2
Cooperating Institutions	Lund University, KTH
Matching Fund	1. The Swedish Governmental Agency for Innovation Systems (VINNOVA)・VINNOVA Berzelii Centers 2. European Union・7th Framework Programme 3. VINNOVA・Innovations for Future Health

Country	Australia
Core Institution	University of South Australia
Co-Chair (name and title)	Prof. John Ralston
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	1. Australian Research Council・LP0667828 2. Australian Research Council・DP1094337

Country	The United States of America
Core Institution	IBM Watson Research Center
Co-Chair (name and title)	Watson Research Center・IBM fellow/Vice president・ Dr. Tze-Chiang Chen
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	IBM Corporation・Corporation money

Country	Singapore
Core Institution	Nanyang Technological University
Co-Chair (name and title)	Prof. Ai-Qun Liu
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	Singapore Environment & Water Industry Development Council · IRIS Scheme · NRF-EWI Fund Project

Country	Switzerland
Core Institution	Swiss Federal Institute of Technology Zurich, Switzerland
Co-Chair (name and title)	Prof. Petra Dittrich
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	European Research Council · ERC Starting Independent Researcher Grant

Result of Program Implementation

In this program, based on the results obtained in the previous program cooperating with Uppsala University (Sweden) which has single molecule detection method and South Australia University (Australia) which has methodology of surface chemistry, we are constructing research/education core in the University of Tokyo. Fundamental scientific findings on single molecule analysis are being reported toward single cell and single molecule analysis. In order to promote the research, we newly added IBM Watson Research Center (USA) which has MEMS and IT technology, Nanyang Technological University (Singapore) which has photonics technology, and Swiss Federal Institute of Technology (Switzerland) which has fluorescent molecule detection technology. By this enhanced research promotion, engineering field of single cell and single molecule analysis will be established, and the first core covering micro and nano chemistry fields, which can provide new analysis tools for medical and biological fields, will be constructed. From the view point of geography, this program can cover Europe, Asia, Oseania and America. Since each institute is a hub in each area, this program can be a strong international network among these regions. Based on this network, young researchers can exchange internationally, and grow their discussion ability in English. Therefore, this program is becoming a basis for both research and exchange, and has been constructing a continuous research exchanging system.

Achievements in FY2012 (Self Review)

Based on single molecule detection method established in the previous program using microchannels, we are constructing science and engineering methodologies for single cell analysis using extended-nano channels (10–100 nm size) which is far smaller than normal microchannels (10–100 μ m size). Specifically, co-working with Uppsala University, we have further developed Rolling Circle Amplification for single molecule detection using nonfluorescent molecule detection method. This technique could achieve ultra-high speed detection in micro/nanochannels. In addition, on-chip cell analysis device using RCA method integrating cell trapping, pre-treatment and detection could be developed. Co-working with South Australia University, we have developed a chemical valve in extended nanochannel based on surface chemistry, which is fundamental method for single cell analysis device. Also, a microfluidic extraction method using two-phase flow has been developed. Co-working with IBM, we developed low temperature glass bonding method for incorporating nanowire sensor in extended-nano channels. Co-working with Swiss Federal Institute of Technology, we discussed about cell culturing method in microchannel for analytical device of living cells. These results are important knowledge to develop novel devices for single cell and single molecule analysis by fluid engineering based on extended nanospace. Because of final year of this project, we had an international symposium "Micro and Extended-Nano Space Chemistry and Perspective of Next-Generation Analytical Devices" for summarizing both collaborative research and education. About 150 people attended the symposium and broad-ranging and deep discussion has been made for science and engineering for single cell analysis.

Future Plan (Measures toward Achieving Research Objectives)

Based on the established molecule detection and surface control methodologies, we will develop single cell and single molecule analysis method using extended-nanochannels. Continuing the exchanging will produce new fields by exchanging with completely different fields such as Uppsala university (Medicalbio), South Australia University (Surface chemistry) and IBM(IT, MEMS/NEMS), Nanyang Technological University (Photonics) and Swiss Federal Institute of technology (Fluidics, Biology). The University of Tokyo will promote collaborations among these institutes, combine the research and develop single cell analysis devices for medical applications. The devices will be developed for Circulating tumor cell (CTC) analysis and stem cell (ES or iPS cells) analysis.