【Grant-in-Aid for Specially Promoted Research】
Science and Engineering (Engineering)

Title of Project：Creation of fluid engineering in extended-nano space

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Research Area：Fluid Engineering, Micro/nanodevice

Keyword：Extended-nano Space, Micro chemical system

【Purpose and Background of the Research】

Nanotechnology exploiting quantum effects and near-field light and so on has developed science and engineering in electronics and photonics fields. By contrast, we have studied on micro chemical systems integrating various chemical operations such as reaction and extraction in microchips with microchannels in μm order by using micro-fabrication technology (Fig.1). So far, we have developed rapid, efficient micro chip technology exploiting space characteristics that surface properties affect on fluid behavior due to size effects and applied it to rapid diagnosis systems and so on. Such technologies are summarized in Fig. 1 focusing on size order. The extended nano scale, 10^1–10^3 nm scale is larger than macromolecular and smaller than micro fabrication field. Also, extended nano scale is larger than single molecule and smaller than size where liquids keep their original properties. Therefore, extended nano space is scientifically interesting, but there has been no experimental tool.

Therefore, in this program, we establish the basic technologies including fabrication, fluidi control methods, single molecule detection methods, and clarify the physics and chemistry in extended-nano space for future innovative applications.

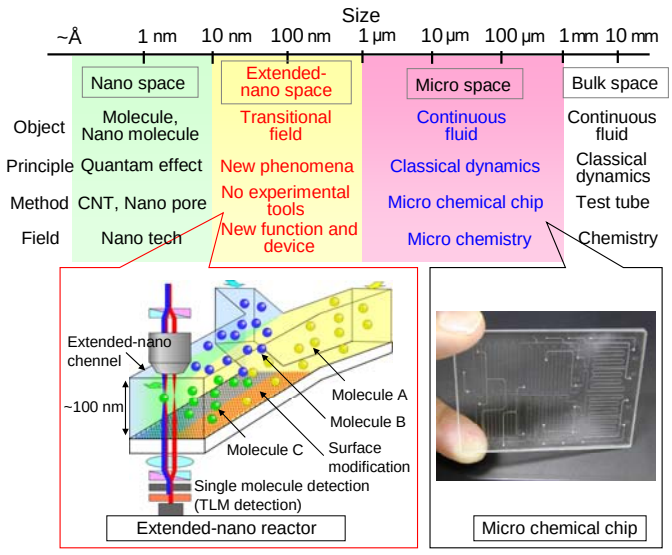

Fig. 1. Research Concept

【Research Methods】

Plan A: Establishment of technology

A-1) Fabrication and modification

In addition to top-down fabrication, we develop partial chemical surface modification method in extended-nano channels.

A-2) Fluid control

We control surface wettability to control fluid in extended-nano space where mechanical fluidic devices are difficult to be incorporated.

A-3) Detection

We realize single molecule detection applying our original sensitive non-fluorescent molecule detector, thermal lens microscope (TLM).

Plan B: Solution of physical/chemical properties

B-1) Liquid properties and structures

Liquid Properties (density, specific heat and refractive index) and structures are measured by spectroscopic analytical method.

B-2) Chemical reactions

Chemical reactions in extended-nano space are realized and investigated.

B-3) Properties in bio-extended-nano space

Bio-extended-nano space imitating space between cells is realized and investigated.

【Expected Research Achievements and Scientific Significance】

This study not only opens new disciplines, but also gives new engineering methods. This study can give molecular sketch to electric double layer, and can be applied to various novel devices such as ultra effective analysis devices and new principle energy devices.

【Publications Relevant to the Project】

1. T. Tsukahara, A. Hibara, Y. Ikeda, T. Kitamori, "NMR Study of Water Molecules Confined in Extended-Nano Spaces", *Angew. Chem. Int. Ed.*, **46**, 1180-1183 (2007)
2. T. Kitamori, M. Tokeshi, A. Hibara, K. Sato, "Thermal lens microscopy and microchip chemistry", *Anal. Chem.*, **76**, 52A-60A (2004)

【Term of Project】 FY2009-2012

【Budget Allocation】 418,800 Thousand Yen

【Homepage Address and Other Contact Information】

http://park.itc.u-tokyo.ac.jp/kitamori/top_e.htm