FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Development of A Novel Nanofluidic-based Separation System for Rare-Earth Elements	
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1. Background of research

Rare earth elements and compounds has become of interest as advanced materials for a variety of applications in analysis, electronics, photonics, and so on. However, the stable supply of rare earth elements cannot be guaranteed, because > 90 % rare earth elements are produced in China. Recently, recovery and recycling from spent wastes including rare earth elements (called urban mines) have been performed using conventional wet and dry processes, while their performances are quite insufficient. This reason is because the conventional methods need time-consuming and high environmental impact chemical operations. Therefore, an innovative separation method differing from conventional methods should be developed.

2. Research objectives

In this project, I aim to establish “the science and technology of nanofluidic-based selective separation for rare earth elements” which can be realized by utilizing unique liquid properties, fluid behaviors, and surface functions in 100 nm-sized nanofluidic channels. The proposal is composed of the following three topics: (1) Physicochemically nanopattering (pillars, particles, and polymers), (2) Demonstration of nanofluidic-based separation, (3) Spectroscopic analysis of ion-hydration and examination of mechanism.

3. Research characteristics (incl. originality and creativity)

Since a nanofluidic space (10 – 100 nm scale space) is a technologically and scientifically unexplored and attractive region, the nanofluidic-based separation technique makes it possible to control actively the ion transport behavior at single molecular cluster level. Moreover, even similar ion species such as rare-earth metals should be mutually separated by only flowing into nanofluidic channels. The research strategy and methodology are quite original and challenging.

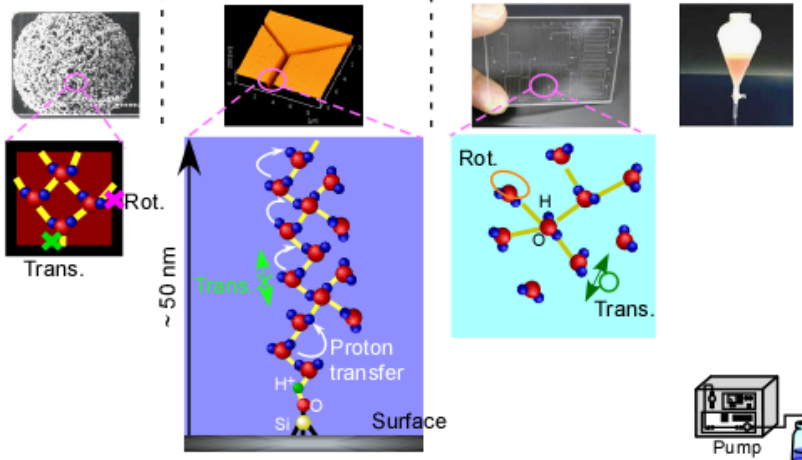
4. Anticipated effects and future applications of research

The research outcomes of this project will create recovery and recycling techniques of valuable materials such as rare metal elements, the management of liquid wastes, and their related social science for solving many global and environmental problems, which threat to human life. It will also have important advances for the understanding of basic science and for evolution in various fields of chemistry.

【Unique Properties of Nanofluidcis】

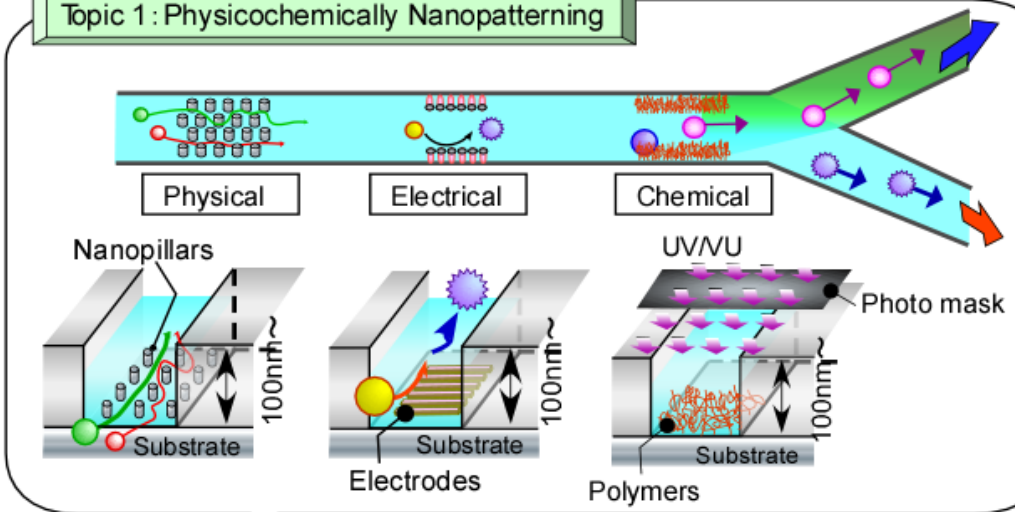
1nm 10nm 100nm 1mm 10mm 100mm 1mm

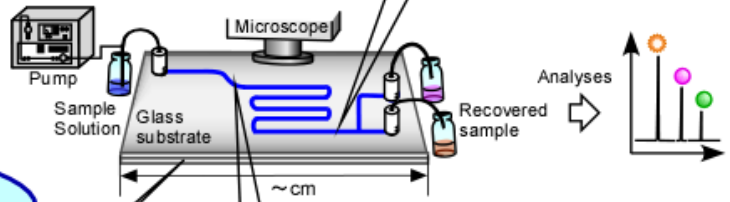
Nanopore	Nanofluidics	Micro	Bulk
・Ice-like	・Highly ordering	・Liquid	・Liquid



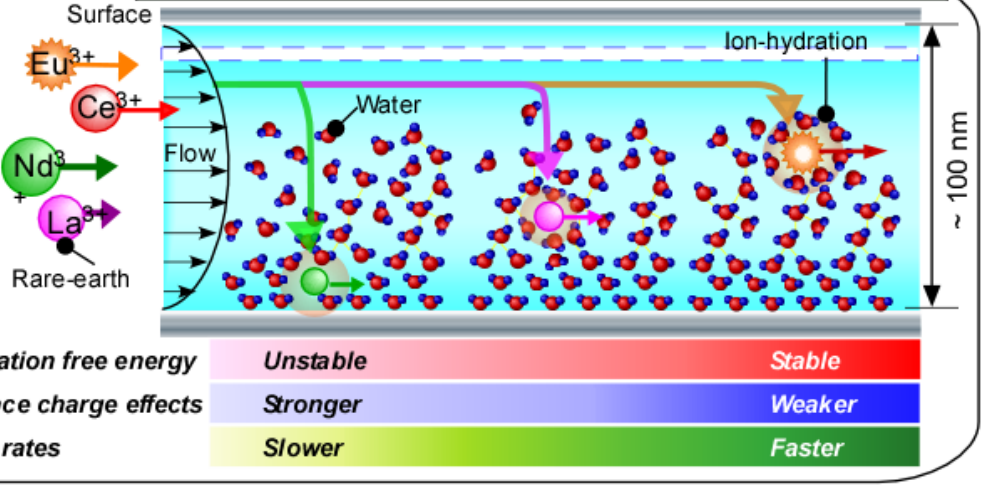
Establishment of an innovative nanofluidic-based separation methodology and technology for rare earth elements by using unique 100 nm scale spaces

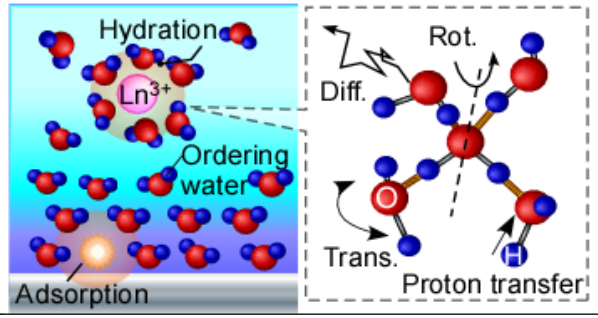
Topic 1 : Physicochemically Nanopatterning





Topic 2 : Demonstration of nanofluidic-based separation



Topic 3 : Spectroscopic analysis of ion-hydration

▶ Investigation of Molecular Dynamics of Ion hydration and Examination of Separation Mechanisms.