SEMINAR SERIES

International Institute for Carbon-Neutral Energy Research
Kyushu University

Title

Manipulation of molecular machines and nanocars by cm-level hand-like motions? or nm-size tip approach?

Speaker

Prof. Katsuhiko Ariga
WPI-MANA, National Institute for Materials Science, Japan,
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Date & Time

Tuesday, July 4, 2017 4:00 p.m.

Place

I²CNER Hall, Ito campus, Kyushu University

Abstract

Functional materials have been wisely constructed via bottom-up approaches as seen in preparation of molecular and nano patterns and complexes, organized nanostructures, and function materials. However, novel concepts to bridge nano (molecular) structures and bulk systems now becomes crucial in order to control real nano and molecular functions from our visible macroscopic worlds. Here we propose a novel methodology "hand-operating nanotechnology" where molecular orientation, organization and even functions in nanometer-scale can be operated by our macroscopic (hand) operation. This concept can be realized at dynamic two-dimensional medium such as thin films at the air-water interface because this medium possess both features of bulk and molecular dimension. For example, we successfully manipulated molecular machines at the air-water interface upon bulk (10-100 cm size) motion of the entire monolayer and realized "capture and release" of aqueous guest molecules using molecular machine, steroid cyclophane. In addition, mechanically controlled chiral recognition of amino acid and discrimination of nucleosides by the supramolecular monolayer was successfully demonstrated. The concept has been also applied to indicator-displacement assay for sensor usage. In recent attempts with molecular pliers as model machines at the air-water interface, closing and opening motions of the pliers were estimated and simulated by density functional theory and molecular dynamics calculation, which were further compared with macroscopic mechanical energies of the interface by thermodynamic calculation (see Figure). The obtained results indicated highly efficient conversion of the mechanical energy in tens of centimeter-scale motion into subnanometer-scale modulations of the molecular pliers. In addition, recent results of the nanocar race with nm-level STM tip operation will be reported.

About the Speaker

Prof. Katsuhiko Ariga earned his Ph.D in Polymer Chemistry from Tokyo Institute of Technology (TIT) in 1990. He was an Assistant Professor at TIT, worked as a postdoctoral fellow at the University of Texas at Austin, USA, and then served as a group leader in the Supermolecules Project, JST. Thereafter, he worked as an Associate Professor at the Nara Institute of Science and Technology and then got involved with the ERATO Nanospace Project, JST. In January 2004, he moved to the National Institute for Materials Science (NIMS). He is now working as a group leader of Supermolecules Group and Principal Investigator of World Premier International (WPI) Research Center for Materials Nanoarchitectonics (MANA) at NIMS. From April in 2017, he is co-appointed University of Tokyo as a professor. He is Editorial Advisory Board members of *Langmuir (-2014)*, *Chem. Mater*, *ACS Appl. Mater. Interfaces*, *Adv. Mater.*, *Jpn. J. Appl. Phys.*, *Nanotechnology*, *Phys. Chem. Chem. Phys.*, and so on. Since 2017, he is Editor-in-Chief of Bull. Chem. Soc. Jpn. He has authored or co-authored ca 600 papers (H-index; 88, May. in 2017, Web of Science). Since 2014, he has been selected as highly cited researcher (Thompson Reuter, Clarivate Analytics).

Host: Professor Atsushi Takahara

Co-hosted: Institute for Materials Chemistry and Engineering, Kyushu University
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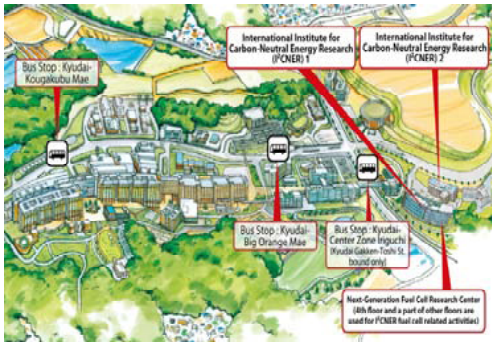

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