

Can we operate molecular machines by our hands?

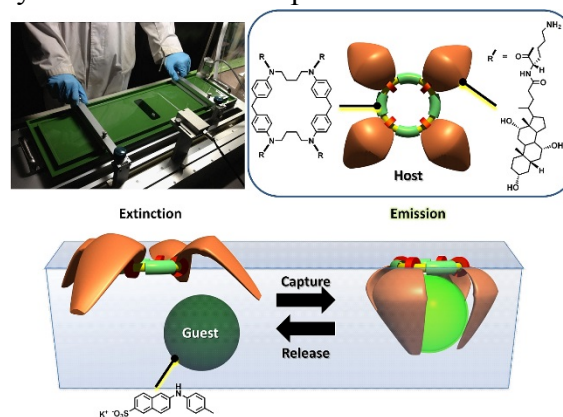
Hand-Operating Nanotechnology: World Stupidest Approach for Energy Most Efficient Molecular Manipulation

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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 (see Figure). 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.



These examples demonstrate our new concept, manual nanotechnology so-called, hand-operating nanotechnology, with which we can manually control nano/molecular phenomena and functions by macroscopic mechanical force such as hand motions. Using hands for functional operation would be most environmentally friendly and least energy consuming technology.



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1987-1992	Assistant Professor (Tokyo Institute of Technology)
1990-1992	Postdoctoral Researcher (University of Texas at Austin)
1992-1998	JST Group Leader (Supermolecules Project) and CREST Researcher
1998-2001	Associate Professor (Nara Institute of Science and Technology)
2001-2003	JST Group Leader (Nanospace Project)
2004-	Director of Supermolecules Group, NIMS
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2011 ISCB Award for Excellence 2011 (Indian Society of Chemists and Biologists)
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