

**Investigation of Mechanical Manipulation of Atoms and Molecules on Insulator Surfaces with Extreme Field Atomic Force Microscopy**

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**【Outline of survey】**

The purpose of the present project is to develop the unexplored techniques of mechanically manipulating atoms and molecules on insulator surfaces as well as to investigate of the physical properties of the assembled nano-structures, with the noncontact atomic force microscopy operating under extreme fields such as low temperatures, high magnetic fields and ultrahigh vacuum. The details of the projects are as follows.

- 1) Clarification of the control conditions and the mechanism to mechanically manipulate atoms and molecules on insulator surfaces.
- 2) Assembling the nano-structures and clarification of the physical properties.
- 3) Mechanical manipulation of magnetic atoms in high magnetic fields and clarification of the magnetic interaction.
- 4) Investigation of novel spin states of electrons for assembled magnetic nano-structures.

**【Expected results】**

This project is expected to open a novel research field concerned with the manipulation/assembly of atoms and molecules in insulator surfaces. In addition, the results of this project are expected to offer key technologies in a wide variety of fields related to the nanotechnology. Furthermore, the manipulation of magnetic atoms enables us to assemble new magnetic nano-structures. By investigating the physical properties of the nano-structures, we can get knowledge for the quantum spin states of electrons in the nano-structures. Such knowledge will bring a huge contribution to the progress of the spintronics (spin-based electronics) which controls the quantum spin states of electrons.

**【References by the principal investigator】**

- Y. Naitoh, K. Momotani, H. Nomura, Y. J. Li, M. Kageshima, and Y. Sugawara: *J. Phys. Soc. Jpn.*, 76, 2007, 033601(4pages).
- Y. J. Li, H. Nomura, N. Ozaki, Y. Naitoh, M. Kageshima, Y. Sugawara, C. Hobbs and L. Kantorovich: *Phys. Rev. Lett.*, 96, 2006, 106104(3pages).
- Y. Sugawara: “Applied Scanning Probe Methods VI”, ed. by B. Bhushan, H. Fuchs, S. Kawata, Springer, 2006, Chapter 18, 247-255.

**【Term of project】** FY2008—2012

**【Budget allocation】**

70,900,000 yen (direct cost)

**【Homepage address】**

<http://www.eng.osaka-u.ac.jp/ap1/g3/sugawaralab/>