Surface Atomic-layer Superconductors on Silicon: Electron Transport, STM, and Control with Molecules

Takashi Uchihashi
International Center for Materials Nanoarchitectonics (MANA),
National Institute for Materials Science (NIMS), Tsukuba, Japan

E-mail: UCHIHASHI.Takashi@nims.go.jp

Surface reconstructions of silicon and related semiconductors with metal adatoms constitute a family of highly-ordered low dimensional materials, which are fundamentally different from their bulk counterparts. In this talk, I report on the superconductivity of Si(111)-(√7×√3)-In surface revealed by lateral electron transport measurement and scanning tunneling microscopy (STM) studies [1-4]. The superconducting transition was evidenced by observations of the zero resistance state and *I−V* characteristics exhibiting sharp switching below 3 K. Superconducting vortices were observed by taking differential conductance (*dI/dV*) images using an STM at 0.5 K while magnetic field was applied. Vortices trapped along atomic steps exhibits characteristics of Josephson vortex, showing that an atomic step works as a Josephson junction (Fig. 1). Furthermore, we found that different kinds of phthalocyanine (Pc) molecules self-assembled on the Si(111)-(√7×√3)-In surface modified its superconductivity according to their magnetic properties. This clearly shows the possibility of controlling the macroscopic superconducting properties of surface reconstructions utilizing its surface sensitivity.

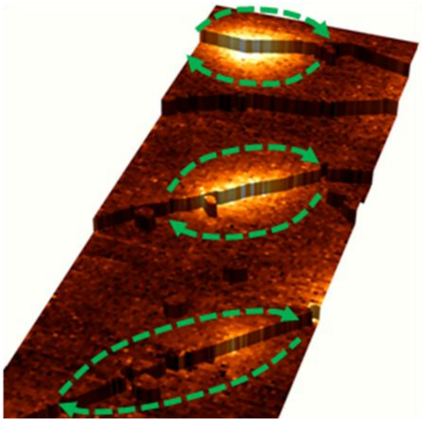

Fig.1 3D representation of vortices trapped along the atomic steps of a Si(111)-(√7×√3)-In surface. The color scale indicates the zero bias conductance measured using STM while the height topographic height.

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Dr. Takashi Uchihashi
Senior researcher
International Center for Materials Nanoarchitectonics (MANA)
National Institute for Materials Science (NIMS)
1-1, Namiki, Tsukuba, Ibaraki 305-0044, Japan
phone: +81-29-860-4150
e-mail: UCHIHASHI.Takashi@nims.go.jp

Education
1995 Ph.D. in Science from the University of Tokyo

Professional Experience
1995 Researcher, National Research Institute for Metals, Japan
2003-2008 Researcher, Nanoscale Quantum Conductor Array Project, ICORP, JST
2004 - Present Senior researcher (MANA Scientist), National Institute for Materials Science, Japan
2006 Visiting researcher, Institute of Experimental and Applied Physics, Christian-Albrechts-Universität zu Kiel, Germany
2015 Visiting professor, Yokohama City University, Japan

Fields of Research
Surface Science, Nanomaterials, Low-temperature Physics

Publications

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