Hideo Kaiju, J Material Sci Eng 2015, 4:3
http://dx.doi.org/10.4172/2169-0022.C1.031

OMICS International
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International Conference and Exhibition on
Mesoscopic & Condensed Matter Physics
June 22-24, 2015 Boston, USA

Nanoscale junctions utilizing magnetic thin-film edges

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Recently, we have proposed a new method for the fabrication of nanoscale junctions utilizing thin-film edges. In this method, the edges of two metal thin films are crossed, and molecules, metal-oxide, etc. are sandwiched between their two edges. The junction area is determined by the film thickness, in other words 10 nm thick films could produce 10×10 nm2 nanoscale junctions. This method offers a way to overcome the feature size limit of conventional optical lithography. Moreover, novel spintronics devices, such as large magneto resistance devices and spin-filter devices, could be created when magnetic materials are used as metal thin films. In this presentation, we report the detail fabrication technique for nanoscale junctions and discuss the structural and electrical characteristics in various nanoscale junctions. The results include the observation of ohmic characteristics in Ni/Ni devices, nanoscale tunneling phenomena in Ni/NiO/Ni devices, and the ballistic regime of nanoscale molecules in Ni/P_3HT:PCBM/Ni devices. Moreover, we report ongoing spintronics devices utilizing stray magnetic fields as a new type of spin-filter device. This device consists of inorganic complexes or quantum dots (QDs) sandwiched between two crossed edges of magnetic thin films. In this structure, a high magnetic field could be locally generated in the inorganic complexes or QDs due to the contributions of the stray field from both edges of the magnetic thin films. Since a large magnetic field produces a large Zeeman effect, energy splitting of the inorganic complexes or QDs can be enhanced. Therefore, a large spin-filter effect can be expected. In this talk, we will focus on the structural and magnetic properties in our proposed nanoscale spintronics devices.

Biography

Hideo Kaiju received his PhD from Keio University in 2005. During the Doctoral course, he worked as a Research Fellow of the Japan Society for the Promotion of Science (JSPS). He worked as a Research Associate from 2004-2007 and an Assistant Professor from 2007-2013 in Research Institute for Electronic Science (RIES) at Hokkaido University. From 2009-2013, he also worked as a Precursory Research for Embryonic Science and Technology (PRESTO) Researcher of Japan Science and Technology Agency (JST). From 2013 to the present, he worked as an Associate Professor in RIES at Hokkaido University. He has published more than 45 papers, including original and review articles. He also received academic awards, including Keio Engineering Society Award in 2000, Applied Physics and Physico-Informatics Award in 2002, Matsumoto-Hadori Award in 2007, and MRS Best Poster Presentation Award and MSJ Young Scientist Award in 2014.

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