July 12, 2010

# Press Release

Tohoku University

## Development of a High-Performance Perpendicular Magnetic TMR Device for Logic Integrated Circuits

Toward Ultra-Low-Power System-On-Chips Combining a Non-Volatile Spintronics Device and Semiconductor Logic Integrated Circuit

A research group led by Professor Shoji Ikeda and Professor Hideo Ohno of the Center for Spintronics Integrated Systems and Research Institute of Electrical Communication at Tohoku University (President: Akihisa Inoue) has joined forces with Hitachi Ltd. (President: Hiroaki Nakanishi) in industry-academia cooperative research to develop a high-performance perpendicular magnetic tunneling magneto-resistance (TMR) device for achieving non-volatile semiconductor logic integrated circuits. This device uses large perpendicular magnetic anisotropy at the interface between an insulator and magnetic electrode to simultaneously achieve—for the first time in the world—the following four items essential to logic integrated circuits:

(1) High non-volatility at a device dimension of 40 nm
(2) High tunneling-magneto-resistance ratio of 124%
(3) Low write current of 49 μA
(4) Thermal resistance of 350°C as required in standard manufacturing processes used for logic integrated circuits

In addition, this newly developed TMR device achieves these essential items without using noble-metal materials providing a great advantage in terms of resource conservation and cost reduction. On converting to memory capacity, the device dimension of 40 nm corresponds to 8 Gbits of memory. Using this TMR device to make semiconductor logic integrated circuits non-volatile has opened the door to achieving ultra-low power consumption in system-on-chip (SOC) logic integrated circuits that regulate electronic equipment to achieve high performance and high energy savings.

This work was supported by the FIRST program of JSPS and by the “High-Performance Low-Power Consumption Spin Devices and Storage Systems” program of MEXT, and a GCOE program at Tohoku University.

The results have been published as Advance Online Publication 'A perpendicular-anisotropy CoFeB-MgO magnetic tunnel junction' on Nature Materials's website.

Contact: Professor Shoji Ikeda, Center for Spintronics Integrated Systems, Tohoku University, Japan, phone & fax +81-22-217-5555, e-mail sikeda@csis.tohoku.ac.jp