



**The 2nd CSIS International Symposium
on Spintronics-based VLSIs**

and

**The 8th RIEC International Workshop
on Spintronics**

Date: February 2nd and 3rd, 2012

Venue: Laboratory for Nanoelectronics and Spintronics,
4th Floor, Conference Room, Tohoku University,
Sendai, Japan

<http://www.csis.tohoku.ac.jp/>

Symposium Registration

Registration: E-mail to CSIS Support Office (sien@csis.tohoku.ac.jp) by January 26th, 2012.

Symposium Fee: Free

Banquet Registration

Advance Registration: E-mail to CSIS Support Office (sien@csis.tohoku.ac.jp) by January 26th, 2012.

Banquet Fee: 5,000 JPY
Banquet Fee will be collected on site at the Symposium

Sponsors

The symposium and the workshop are sponsored and supported by:

- Cabinet Office, Government of Japan
- Ministry of Education, Culture, Sports, Science & Technology, Japan
- Japan Society for Promotion of Science (JSPS) through the “Funding Program for World-Leading Innovative R&D on Science and Technology (the FIRST Program)”
- Research Institute of Electrical Communication (RIEC), Tohoku University

Organizers

Hideo Ohno (CSIS and RIEC, Tohoku University)

Tetsuo Endoh (CSIS and Center for Interdisciplinary Research, Tohoku University)

Naoki Kasai (CSIS, Tohoku University)

Takahiro Hanyu (CSIS and RIEC, Tohoku University)

Yasuo Ando (CSIS and Graduate School of Engineering, Tohoku University)

Shoji Ikeda (CSIS and RIEC, Tohoku University)

Michihiko Yamanouchi (CSIS, Tohoku University)

Hideo Sato (CSIS, Tohoku University)

Local Staff

Yutaka Kadowaki (CSIS, Tohoku University)

Noriko Sato (CSIS, Tohoku University)

Yuko Jidai (CSIS, Tohoku University)

Manami Abe (CSIS, Tohoku University)

Osamu Sugasawa (CSIS, Tohoku University)

PROGRAM

Thursday February 2nd, 2012 - Materials and Devices -		
Opening 9:00 -9:10		Opening remarks <u>Hideo Ohno</u> (Tohoku University)
Invited talk 9:10-9:45	T1	Size-dependent sub-volume magnetic excitation in perpendicularly magnetized tunnel junctions and implications for spin-torque-based memory technologies <u>Jonathan Z. Sun</u> (IBM)
Invited talk 9:45-10:05	T2	Thermal stability factor of CoFeB/MgO perpendicular magnetic tunnel junctions <u>Hideo Sato</u> , M. Yamanouchi, K. Miura, S. Ikeda, R. Koizumi, F. Matsukura, and H. Ohno (Tohoku University)
10:05-10:20	Coffee Break	
Invited talk 10:20-10:55	T3	Tetragonal Mn-Ga alloys for MRAM application <u>Shigemi Mizukami</u> (Tohoku University)
Invited talk 10:55-11:30	T4	Magnetic properties and tunnel magneto-resistance effect of perpendicularly magnetized L1₀-ordered alloys <u>Mikihiko Oogane</u> , M. Hosoda, H. Saruyama, N. I. Khan, G. Kim, N. Inami, H. Naganuma and Y. Ando (Tohoku University)
Invited talk 11:30-12:05	T5	MRAM concepts for sub-20nm scaling and ultrafast precessional switching <u>Ricardo Sousa</u> ¹ , S. Bandiera ¹ , M. Marins de Castro ¹ , B. Lacoste ¹ , C. Ducruet ² , S. Auffret ¹ , I. L.Prejbeanu ² , U. Ebels ¹ , C. Portemont ² , L.D. Buda-Prejbeanu ¹ , B. Rodmacq ¹ , and B. Dieny ¹ (¹ SPINTEC, ² Crocus)
12:05-14:00	Lunch	
14:00-15:30	POSTER SESSION See pages 5 and 6	
Invited talk 15:30-16:05	T6	STT-MRAM development with 300-mm facilities at LEAP <u>Toshihiro Sugii</u> , M. Aoki, H. Noshiro, T. Ochiai, K. Tsunoda, Y. Iba, A. Hatada, M. Nakabayashi, Y. Yamazaki, A. Takahashi, and C. Yoshida (LEAP)
Invited talk 16:05-16:25	T7	Magnetic resonance and switching induced by the Spin Hall effect <u>Luqiao Liu</u> ¹ , C. F. Pai ¹ , O. J. Lee ¹ , T. J. Gudmundsen ¹ , D. C. Ralph ^{1,2} and R. A. Buhrman ¹ (¹ Cornell University, ² Kavli Institute at Cornell)

Invited talk 16:25-17:00	T8	<p>Current induced magnetization dynamics in CoFeB/MgO nanostructures</p> <p><u>Masamitsu Hayashi</u>¹, J. Kim¹, J. Sinha¹, S. Mitani¹, Y. Nakatani² S. Fukami³, M. Yamanouchi³ and H. Ohno³ (¹NIMS, ²University of Electro-Communications, ³Tohoku University)</p>
17:00-17:15	Coffee Break	
Invited talk 17:15-17:50	T9	<p>Current-induced domain wall motion in the presence of spin-orbit coupling</p> <p><u>Kyung-Jin Lee</u>^{1,2,3}, S.-M. Seo¹, K.-W. Kim⁴, J. Ryu⁴, and H.-W. Lee⁴ (¹Korea University, ²NIST, ³University of Maryland, ⁴Pohang University of Science and Technology)</p>
Invited talk 17:50-18:25	T10	<p>Magnetoresistance and spin-transfer torque in magnetic tunnel junctions</p> <p><u>Shinji Yuasa</u>^{1,2}, K.Yakushiji¹, H.Kubota¹, A.Fukushima¹ and K.Ando¹ (¹AIST, ²IEEE Distinguished Lecturer)</p>
Invited talk 18:25-19:00	T11	<p>Racetrack Memory 2.0: a high-performance, storage class memory using perpendicularly magnetized domain-walls manipulated by current</p> <p><u>Stuart Parkin</u> (IBM)</p>
Banquet 19:30-21:00	<p>Barbaresco (Italian restaurant), Sendai Trust City Plaza, 1st floor http://www.stillfoods.com/barbaresco/location.html</p>	

Friday February 3rd, 2012

Spintronics-based LSIs

Invited talk 9:00-9:35	F1	Restructuring of memory hierarchy in electrical system and no-standby-power nonvolatile logic with STT-RAM technology <u>Tetsuo Endoh</u> (Tohoku University.)
Invited talk 9:35-10:10	F2	STT MRAM: Recent strong semiconductor Industry traction <u>Yiming Huai</u> , Y. Zhou, Z. Wang, R. Malmhall, R. Ranjan and J. Zhang (Avalanche Technology)
Invited talk 10:10-10:45	F3	Embedded STT-MRAM for advanced mobile system-on-chips: Current status and prospects <u>Seung Kang</u> (Qualcomm)
10:45-11:00	Coffee Break	
Invited talk 11:00-11:35	F4	SPRAM (SPin-transfer torque RAM) technology for environmentally-friendly social innovation <u>Masanori Odaka</u> (Hitachi)
Invited talk 11:35-12:10	F5	Design considerations for 1T-1STT MTJ based embedded memory arrays <u>Arijit Raychowdhury</u> (Intel)
12:10-14:00	Lunch	
Invited talk 14:00-14:35	F6	Proposal of new MTJ-based nonvolatile memories <u>Takashi Ohsawa</u> , Hiroki Koike, Shoji Ikeda, Takahiro Hanyu, Hideo Ohno, and Tetsuo Endoh (Tohoku University)
Invited talk 14:35-14:55	F7	A content addressable memory using three-terminal magnetic domain wall motion cells <u>Ryusuke Nebashi</u> ¹ , N. Sakimura ¹ , Y. Tsuji ¹ , S. Fukami ² , H. Honjo ¹ , S. Saito ¹ , S. Miura ¹ , N. Ishiwata ¹ , K. Kinoshita ² , T. Hanyu ² , T. Endoh ² , N. Kasai ² , H. Ohno ² , and T. Sugibayashi ¹ (¹ NEC, ² Tohoku University)
Invited talk 14:55-15:15	F8	High-density ternary content-addressable memory using MTJ-based nonvolatile logic-in-memory architecture <u>Takahiro Hanyu</u> , (Tohoku University)
15:15-15:30	Coffee Break	
Panel Discussion 15:30-17:00	“Spintronics-based VLSIs, What remains to be done?” Moderators : Hideo Ohno (Tohoku University), Tetsuo Endoh (Tohoku University) Panelists : Yasuo Ando(Tohoku University), Yiming Huai(Avalanche), Seung Kang(Qualcomm), Shoji Ikeda(Tohoku University), Kyung-Jin Lee(Korea University), Stuart Parkin(IBM), Ricardo Sousa(Spintec), Jonathan Sun(IBM), Takahiro Hanyu(Tohoku University), Tadahiko Sugibayashi(NEC), Toshihiro Sugii(LEAP)	
Closing 17:00-17:05		Closing remarks

Thursday February 2nd, 2012

POSTER SESSION 14:00-15:30

P1	Effects of rapid thermal annealing on magnetic coupling of chromium-doped indium zinc oxides C.Y. Hsu (National Sun Yat-Sen University)
P2	Magneto-optical studies of Co doped amorphous carbon films H. S. Hsu ¹ , W. Y. Su ^{1,4} , J. S. Lee ¹ , S. J. Sun ² , P. Y. Chuang ³ , and C. H. Lee ³ (¹ National Pingtung University of Education, ² National University of Kaohsiung, ³ National Tsing-Hua University, ⁴ National Kaohsiung Normal University)
P3	Annealing temperature dependence of tunnel magnetoresistance in MgO magnetic tunnel junctions with thin CoFeB electrodes H. D. Gan ¹ , S. Ikeda ¹ , M. Yamanouchi ¹ , H. Sato ¹ , K. Miura ^{1,2} , K. Mizunuma ¹ , R. Koizumi ¹ , F. Matsukura ¹ , and H. Ohno ¹ (¹ Tohoku University, ² Hitachi)
P4	B concentration dependence of magnetic anisotropy in MgO/CoFeB/Ta stack structure R. Koizumi ¹ , S. Ikeda ¹ , H. Sato ¹ , M. Yamanouchi ¹ , K. Miura ^{1,2} , K. Mizunuma ¹ , H. D. Gan ¹ , F. Matsukura ¹ and H. Ohno ¹ (¹ Tohoku University, ² Hitachi)
P5	Magnetotransport properties in perpendicular magnetized L1₀-CoPt/CoFeB and L1₀-FePd/CoFeB magnetic tunnel junctions H. Naganuma, G. Kim, M. Oogane, and Y. Ando (Tohoku University)
P6	Crystal symmetry change from rhombohedral and tetragonal by substrate temperature for BiFeO₃ epitaxial films H. Naganuma, K. Mukaiyama, M. Oogane, and Y. Ando (Tohoku University)
P7	Effect of device temperature on domain wall motion in a perpendicularly magnetized Co/Ni wire H. Tanigawa, K. Suemitsu, Y. Ozaki, T. Suzuki, and E. Kariyada (Renesas Electronics)
P8	Energy-assisted oxidation process of Mg layer for MgO-MTJs H. Yamamoto ¹ , T. Morita ¹ , S. Ikeda ² , and H. Ohno ² (¹ ULVAC, ² Tohoku University ²)
P9	Spin torque diode effect of perpendicularly magnetized CoFeB/MgO/CoFeB magnetic tunnel junctions N. Inami, H. Naganuma, M. Oogane, Y. Ando, S. Ikeda and H. Ohno (Tohoku University)
P10	Tailoring nonmagnetic-metals/Fe interfaces with perpendicular magnetic anisotropy: A first-principles study Y. Miura, M. Tsujikawa, K. Abe and M. Shirai (Tohoku University)
P11	Ultrafast write operation of reconfigurable spin logic block with SPRAM for 3D-stacked reconfigurable spin processor R. Nakazawa ¹ , H. Kino ¹ , K. Kiyoyama ² , T. Tanaka ¹ , and M. Koyanagi ¹ (¹ Tohoku University, ² Nagasaki Institute of Applied Science)
P12	Ab initio study on magnetic anisotropy of L1₀-FeNi and FeNi multilayers S. Ozaki, Y. Kuwahara, M. Tsujikawa, Y. Miura, K. Abe and M. Shirai (Tohoku University)

P13	<p>Hole concentration dependence of the Curie temperature of (Ga,Mn)Sb channel in field-effect structure</p> <p><u>S. Akita</u>, F. Matsukura and H. Ohno (Tohoku University)</p>
P14	<p>Spin-transfer switching characteristics in magnetic tunnel junctions with synthetic free layers</p> <p>M. Nishimura, <u>M. Oogane</u>, H. Naganuma, N. Inami and Y. Ando (Tohoku University)</p>
P15	<p>First principles study of interface magnetic anisotropy between transition metal nitride (carbide) and Fe(001)</p> <p><u>M. Tsujikawa</u>, Y. Miura and M. Shirai (Tohoku University)</p>
P16	<p>Perpendicular magnetic anisotropy of Co₂FeAl/MgO interfaces</p> <p><u>D. Mori</u>, M. Tujikawa, Y. Miura, K. Abe and M. Shirai (Tohoku University)</p>
P17	<p>7T-2MTJ-Based High-Speed Nonvolatile Fully Parallel TCAM</p> <p>S. Matsunaga, <u>A. Katsumata</u>, M. Natsui, and T. Hanyu (Tohoku University)</p>
P18	<p>Design of a Compact MTJ/MOS-Hybrid Logic Element for a Nonvolatile Field-Programmable Gate Array</p> <p><u>D. Suzuki</u> and T. Hanyu (Tohoku University)</p>
P19	<p>Magnetic proximity effect of Co₂FeAl/(Ga,Mn)As bilayers</p> <p>S. H. Nie^{1,2}, K. K. Meng¹, L. Chen¹, <u>L. J. Zhu</u>¹, X. Z. Yu¹, H. L. Wang¹, W. S. Yan³, Y. G. Zhao², and J. H. Zhao¹ (¹Chinese Academy of Sciences, ²Tsinghua University, ³University of Science & Technology of China)</p>
P20	<p>Nonvolatile Low Power 16-bit/32-bit Binary Counter with MTJ and its Scalability</p> <p><u>S. Togashi</u>, T. Ohsawa and T. Endoh (Tohoku University)</p>
P21	<p>A Study for Adopting PMOS Memory Cell for 1T1R STT-RAM with Asymmetric Switching Current MTJ</p> <p><u>H. Koike</u>, T. Ohsawa and T. Endoh (Tohoku University)</p>