



**The 3rd CSIS International Symposium
on Spintronics-based VLSIs**

and

**The 11th RIEC International Workshop
on Spintronics**

Date: January 31 and February 1, 2013

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 25th, 2013.

Symposium Fee: Free

Banquet Registration

Advance Registration: E-mail to CSIS Support Office (sien@csis.tohoku.ac.jp) by January 15th, 2013.

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:

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- Ministry of Education, Culture, Sports, Science & Technology, Japan
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- Research Institute of Electrical Communication (RIEC), Tohoku University
in cooperation with Nation-wide Cooperative Research Projects

Organizers

Hideo Ohno (CSIS and RIEC, Tohoku University)

Tetsuo Endoh (CSIS and Graduate School of Engineering, Department of Electrical Engineering, 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 and RIEC, 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 January 31, 2013 - Materials and Devices -		
Opening 9:00 -9:10		Opening remarks <u>Hideo Ohno</u> (Tohoku University)
Invited talk 9:10-9:45	T1	Spin Torque MRAM using Perpendicular Magnetic Anisotropy <u>Daniel C. Worledge</u> ¹ , D. W. Abraham ¹ , S. Brown ¹ , M. Gajek ¹ , M. C. Gaidis ¹ , G. Hu ¹ , K. Kita ^{1,2} , J. Nowak ¹ , E. J. O'Sullivan ¹ , R. P. Robertazzi ¹ , J. Z. Sun ¹ , P. L. Trouilloud ¹ , and W. J. Gallagher ¹ (¹ IBM, ² The University of Tokyo)
Invited talk 9:45-10:20	T2	Write Error Rate in STT-MRAM Zihui Wang, Yuchen Zhou, Jing Zhang, Kimi Satoh, Jung Dong Ha and <u>Yiming Huai</u> (Avalanche Technology)
10:20-10:40	Coffee Break	
Invited talk 10:40-11:15	T3	Challenges of STT-MRAM for High Density Memory <u>Gwan-Hyeob Koh</u> (Samsung Electronics)
Invited talk 11:15-11:40	T4	Magnetic tunnel junctions using L1₀ ordered MnAl electrode <u>Mikihiko Oogane</u> , H. Saruyama, Y. Kurimoto, H. Naganuma and Y. Ando (Tohoku University)
Invited talk 11:40-12:05	T5	Junction size dependence of intrinsic critical current and thermal stability of MgO/CoFeB/Ta/CoFeB/MgO recording structure <u>Hideo Sato</u> , M. Yamanouchi, S. Ikeda, S. Fukami, F. Matsukura, and H. Ohno (Tohoku University)
12:05-14:00	Lunch	
Invited talk 14:00-14:35	T6	Comparison between static and dynamic measurements of the spin Hall effect <u>Yoshichika Otani</u> ^{1,2} , K. Kondou ² , Y. Niimi ¹ , S. Kasai ³ , H. Sukegawa ³ , and S. Mitani ³ (¹ The University of Tokyo, ² Riken-ASI, ³ NIMS)
Invited talk 14:35-15:10	T7	Spin transfer torques in magnetic bilayers with strong spin orbit coupling P. M. Haney ¹ , H.-W. Lee ² , K.-Jin Lee ^{3,4,1,5} , A. Manchon ⁶ , and <u>Mark D. Stiles</u> ¹ (¹ National Institute of Standards and Technology, ² Pohang University of Science and Technology, ³ Korea University, ⁴ Korea Institute of Science and Technology, ⁵ University of Maryland, ⁶ King Abdullah University of Science and Technology)
Invited talk 15:10-15:35	T8	Current induced torques in magnetic heterostructures <u>Masamitsu Hayashi</u> ¹ , J. Kim ¹ , M. Yamanouchi ² , S. Fukami ² , T. Suzuki ³ , J. Sinha ¹ , S. Mitani ¹ , and H. Ohno ² (¹ National Institute for Materials Science, ² Tohoku University, ³ Renesas Electronics Corporation)

15:35-15:55	Coffee Break	
Invited talk 15:55-16:20	T9	Three terminal switching devices based on an interconnection material Cu <u>Michihiko Yamanouchi</u> , L. Chen, H. Sato, S. Fukami, S. Ikeda, F. Matsukura, and H. Ohno (Tohoku University)
Invited talk 16:20-16:45	T10	Electric Field-induced Magnetization Switching in CoFeB <u>Fumihiko Matsukura</u> ¹ , S. Kanai ¹ , M. Yamanouchi ¹ , S. Ikeda ¹ , Y. Nakatani ² , and H. Ohno ¹ (¹ Tohoku University, ² University of Electro-communications)
Invited talk 16:45-17:20	T11	First Principles Study on the Gilbert Damping Constants of Transition Metal Alloys <u>Akimasa Sakuma</u> (Tohoku University)
17:20-17:30	Coffee Break	
17:30-19:00	POSTER SESSION See pages 5 and 6	
Banquet 19:30-21:00	CACCINU (Italian restaurant), Sendai Kokusai Hotel*, B1 * http://www.tobu-skh.co.jp/english/index.html	

Friday February 1, 2013

Spintronics-based LSIs

Invited talk 9:00-9:35	F1	Recent Progress in ST-MRAM at Everspin Technologies <u>Jon M. Slaughter</u> , T. Andre, S. Alam, N.D. Rizzo, J. Janesky, R. Whig, F.B. Mancoff, D. Houssameddine, M. L. Schneider, H. -J. Chia, J. J. Sun, S. Aggarwal, K. Nagel, S. Deshpande, B.N. Engel, M. DeHerrera and P. LoPresti (Everspin Technologies)
Invited talk 9:35-10:10	F2	STT-MRAM for Mobile SOC: Embedding Nonvolatile RAM in Application Processors <u>Seung H. Kang</u> (Qualcomm Technologies)
Invited talk 10:10-10:45	F3	High Speed STT-MRAM for Cash Memory and Low Power Nonvolatile Logic with MTJ technology <u>Tetsuo Endoh</u> (Tohoku University)
10:45-11:05	Coffee Break	
Invited talk 11:05-11:30	F4	Standby-Power-Free Fully Parallel TCAM Chip Based on Compact Nonvolatile Logic-in-Memory Cell Structure <u>Shoun Matsunaga</u> ¹ , S. Miura ² , H. Honjo ² , K. Kinoshita ¹ , S. Ikeda ¹ , T. Endoh ¹ , H. Ohno ¹ , and T. Hanyu ¹ (¹ Tohoku University, ² NEC Corporation)
Invited talk 11:30-11:55	F5	Spintronics Primitive Gate with High Error Correction Function <u>Yukihide Tsuji</u> ¹ , R. Nebashi ¹ , N. Sakimura ¹ , A. Morioka ¹ , H. Honjo ¹ , K. Tokutome ¹ , S. Miura ¹ , T. Suzuki ² , S. Fukami ³ , K. Kinoshita ³ , T. Hanyu ³ , T. Endoh ³ , N. Kasai ³ , H. Ohno ³ , and T. Sugibayashi ¹ (¹ NEC Corporation, ² Renesas Electronics Corporation, ³ Tohoku University)
Invited talk 11:55-12:30	F6	MRAM-based Look Up Table for radiation hardened FPGA O.Gonçaves, <u>Guillaume Prenat</u> and B.Dieny (Spintec)
12:30-14:30	Lunch	
Invited talk 14:30-15:05	F7	Prospects and Challenges of Magnetic Domain-Wall Racetrack Memory for High-Density Storage <u>Weisheng S. Zhao</u> ^{1,2} , N. Ben Romdhane ^{1,2} , Y. Zhang ^{1,2} , J-O Klein ^{1,2} , C. Chappert ^{1,2} , R. Mantovan ³ , A. Lamperti ³ , R.P. Cowburn ⁴ , T. Trypiniotis ⁴ , M. Klaui ⁵ , J. Heinen ⁵ , B. Ocker ⁶ , D. Ravelosona ^{1,2} (¹ University of Paris Sud, ² CNRS, ³ Laboratorio MDM IMM CNR, ⁴ Univ Cambridge, ⁵ Johannes Gutenberg Univ Mainz, ⁶ Singulus Technologies)
Invited talk 15:05-15:40	F8	Brain Like Computing Based on the Physics of Nano Devices and Materials <u>Tadashi Shibata</u> (The University of Tokyo)
Invited talk 15:40-16:15	F9	Towards a New Paradigm LSI Based on Nonvolatile Logic-in-Memory Architecture <u>Takahiro Hanyu</u> (Tohoku University)
Closing 16:15-16:20	Closing remarks	

Thursday January 31, 2013

POSTER SESSION 17:30-19:00

P01	Temperature Dependence of Spin Polarization in Co/Ni Nanowires with Different Co and Ni Thicknesses Determined by Domain Wall Dynamics <u>K. Ueda</u> ¹ , R. Hiramatsu ¹ , D. Chiba ^{1,2} , S. Fukami ³ , M. Yamanouchi ³ , H. Ohno ³ , Y. Nakatani ⁴ and T. Ono ¹ (¹ Kyoto University, ² Japan Science and Technology Agency, ³ Tohoku University, ⁴ University of Electro-Communications)
P02	High-speed Simulator Including Accurate MTJ Models for Spintronics Integrated Circuit Design <u>N. Sakimura</u> ¹ , H. Koike ² , R. Nebashi ¹ , Y. Tsuji ¹ , A. Morioka ¹ , H. Honjo ¹ , S. Fukami ² , T. Ohsawa ² , T. Hanyu ² , H. Ohno ² , T. Sugibayashi ¹ and T. Endoh ² (¹ NEC Corporation, ² Tohoku University)
P03	Spin Seebeck Thermoelectric Generators <u>A. B. Cahaya</u> ¹ , G.E.W Bauer ² and O.A Tretiakov ¹ (¹ Tohoku University, ² Delft University of Technology)
P04	Effects of Sputtering Deposition Process on Perpendicular Magnetic Anisotropy of [Co/Pt] Multilayers <u>C. Yoshida</u> , Y. Yamazaki, Y. Iba, T. Takenaga and T. Sugii (Low-power Electronics Association & Project)
P05	Spin torque transistor revisited <u>T. Chiba</u> ¹ , G.E. W. Bauer ^{1,2} , Saburo Takahashi ¹ (¹ Tohoku University, ² Delft University of Technology)
P06	Nonvolatile Look-up Table Circuit Using Three-Terminal MTJ-Based Logic-in-Memory Structure <u>D. Suzuki</u> and T. Hanyu (Tohoku University)
P07	The effects of deposition rate and annealing on CoFeB/MgO/CoFeB perpendicular magnetic tunnel junctions Lin-Xiu Ye, Ching-Ming Lee, Hau-Kang Chen, <u>Te-ho Wu</u> (National Yunlin University of Science and Technology)
P08	The role of B and Co in the perpendicular magnetic anisotropy of CoFeB/MgO interface: a first principles study <u>M. Tsujikawa</u> , Y. Miura and M. Shirai (Tohoku University)
P09	Design of Low-Energy Nonvolatile TCAM Using Logic-in-Memory Architecture <u>S. Matsunaga</u> ¹ , and T. Hanyu (Tohoku University)
P10	Perpendicular magnetic properties and magnetic damping constant of thin CoFeB films <u>M. Oogane</u> , M. Kubota, H. Naganuma, and Y. Ando (Tohoku University)
P11	Spin torque diode effect in magnetic tunnel junction using L1o-ordered free layer <u>H. Naganuma</u> , K. Hatakeyama, G. Kim, Y. Kawada, M. N. I. Khan, N. Inami, M. Oogane, Y. Ando (Tohoku University)
P12	Bias voltage dependence of spin torque diode effect in CoFeB/MgO/CoFeB magnetic tunnel junction <u>Tian Yu</u> , H. Naganuma, N. Inami, M. Oogane, Yasuo Ando (Tohoku University)

P13	Dependence of perpendicular magnetic anisotropy of $L1_0$-FePd/CoFeB films on post-deposition annealing temperature M. N. I. Khan, H. Naganuma, M. Oogane and Y. Ando (Tohoku University)
P14	Depinning error rate of domain wall in Co/Ni nanowire S. Fukami, M. Yamanouchi, S. Ikeda and H. Ohno (Tohoku University)
P15	A New Sensing Scheme with High Signal Margin Suitable for Spin-Transfer Torque RAM H. Koike, T. Ohsawa and T. Endoh (Tohoku University)
P16	600MHz Nonvolatile Latch Based on a New MTJ/CMOS Hybrid Circuit Concept T. Endoh ¹ , S. Togashi ¹ , F. Iga ¹ , Y. Yoshida ¹ , T. Ohsawa ¹ , H. Koike ¹ , S. Fukami ¹ , S. Ikeda ¹ , N. Kasai ¹ , N. Sakimura ^{1,2} , T. Hanyu ¹ , and H. Ohno ¹ (¹ Tohoku University, ² NEC Corporation)
P17	A Fine-Grained Power Gating Architecture for MTJ-based Embedded Memories T. Ohsawa ¹ , H. Kioke ¹ , S. Miura ^{1,2} , H. Honjo ^{1,2} , K. Tokutome ^{1,2} , S. Ikeda ¹ , T. Hanyu ¹ , H. Ohno ¹ , and T. Endoh ¹ (¹ Tohoku University, ² NEC Corporation)
P18	Two-Step Writing Method for STT-MTJ to Improve Switching Probability and Write Speed F. Iga, Y. Suzuki, T. Ohsawa, S. Ikeda, T. Hanyu, H. Ohno, and T. Endoh (Tohoku University)
P19	Magnetic tunnel junctions consisting of Co/Pt multilayer and a CoFeB insertion layer with high thermal stability S. Ishikawa, H. Sato, M. Yamanouchi, S. Ikeda, S. Fukami, F. Matsukura, and H. Ohno (Tohoku University)
P20	Electrical detection of ferromagnetic resonance in (Ga,Mn)As L. Chen, F. Matsukura and H. Ohno (Tohoku University)
P21	Measurement of magnetic properties in CoFeB-MgO p-MTJs by ferromagnetic resonance with homodyne detection technique K. Mizunuma, M. Yamanouchi, H. Sato, S. Ikeda, S. Kanai, F. Matsukura, and H. Ohno (Tohoku University)
P22	Magnetic Field Angle Dependence of the Probabilities of Electric-Field Induced Magnetization Switching S. Kanai ¹ , M. Yamanouchi ¹ , S. Ikeda ¹ , Y. Nakatani ² , F. Matsukura ¹ , and H. Ohno ¹ (¹ Tohoku University, ² University of Electro-communications)