
Ferroelectricity Newsletter

A quarterly update on what's happening in the field of ferroelectricity

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Spring/Summer 2004

A WELL-DESERVED RECOGNITION FOR POSTER SESSIONS

In our last issue, the limelight was on applications of polar dielectrics. This time we will focus on ISIF, the International Symposium on Integrated Ferroelectrics, to be precise, on ISIF 2004 and what we can expect at ISIF 2005.

When I thanked Professor Sunggi Baik, the Technical Program Chair of ISIF 2004, for his part in making the conference such an outstanding success, I mentioned that ISIF 2004 set a new standard for all future meetings. When you read Professor Baik's report on ISIF 2004 (pages 2 and 3), you might get an inkling of what perspired at that conference even if you were not one of the lucky attendees.

One of the new features I especially appreciated was the introduction of "Best Poster Awards" to seven outstanding posters. For the titles and the names of the authors please turn to pages 2 and 3 of this issue. We can take the great increase in poster presentations as a sign of the tremendous growth of the field as a whole. And if we think of it, there are some definite advantages to this form of presentation. First of all, the size is limited which necessitates a compact concentration of the main points. Any communicator knows that it is much easier to compose a longer piece than a short one and convey the same facts.

There is also an advantage for the recipient of the communication. If an idea doesn't make sense right away, one can read the passage again, and if one of the authors is available, one can even ask for further explanation. This is not always possible in oral presentations which have a limited time for questions.

If you look at the topics to be covered at ISIF 2005 (on page 27), you will notice the proliferation of issues to be dealt with. We are lucky indeed that the scope of conference presentations can be easily expanded by increasing the number of poster presentations without adding a day to the traditional duration of the conference.

Our very special thanks go to Professor S. Baik for the excellent report of ISIF 2004 he put together in such a short time. All those scientists and engineers in the field of ferroelectricity who were not among the participants at the conference will truly appreciate Professor Baik's efforts.

Rudolf Panholzer
Editor-in-Chief

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Prof. Rudolf Panholzer
Editor-in-Chief
email: rpanholzer@nps.navy.mil

Dr. Hannah Liebmann
Managing Editor
liebmann@redshift.com

Please visit our Web site:
<http://www.sp.nps.navy.mil/projects/ferro/ferro.html>

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ISIF 2004 REPORT

16TH INTERNATIONAL SYMPOSIUM ON INTEGRATED FERROELECTRICS (ISIF 2004)

The 16th International Symposium on Integrated Ferroelectrics (ISIF 2004) took place on 5 – 8 April at Hotel Hyundai Gyeongju located in the Bomun Lake Resort in the suburb of Gyeongju, Korea, which is the most famous historic city on the Korean peninsula. It was held jointly with the 5th Korean Workshop on High Dielectric and Ferroelectric Devices and Materials.

The ISIF 2004 again proved to be the worldwide prime forum for those involved in the science, technology, and manufacturing of integrated ferroelectric thin film devices and products including the FeRAM which has been considered as one of the most promising next-generation memory devices. Around 400 scientists and engineers from 20 different countries around the world attended the meeting. They presented 415 technical papers including 3 plenary lectures, 46 invited presentations, 128 contributed oral presentations and 243 poster presentations covering the whole spectrum of current topics on ferroelectric thin films and devices, such as FeRAM, MEMS, microwave components, high-K dielectrics, etc.

The ISIF started on Monday, 5 April, with a series of tutorials on fundamentals as well as current burning topics of ferroelectrics, including microstructural and domain issues, MEMS processing and devices, challenges and prospects of FeRAM, high-K gate and capacitor technology, and nanotechnology in ferroelectrics.

The formal symposium started with two plenary lectures; the first one by R. Ramesh (now at UC Berkeley) on “Nanoscale phenomena in synthetic functional oxide heterostructures,” addressing his recent discovery on nanoscale domain dynamics using scanning force microscopy in conjunction with other novel probes, such as scanning microwave microscopy and femtosecond optical probe. The second plenary was given by Takashi Eshida (Fujitsu) on “Technology requirements for future FRAM mass-production,” introducing various issues and obstacles Fujitsu has been facing during five years of mass production of FeRAM for smart cards, particularly on reliability problems. He also addressed several key issues to be resolved for mass-production as Fujitsu moves from current 0.5-0.35 μ m technology to 0.18-0.13 μ m FRAM for cellular phone broad band platforms.

The invited and contributed oral presentations were given in three parallel sessions. The list of titles and authors are posted in this volume. It is interesting to note that the numbers of contributed abstracts increased drastically this year in the sessions on “MEMS applications” and “Microwave materials and devices.” It reflects current R&D trends of active exploration and expansion of scientific and technological know-how developed and accumulated over the years in pursuit of marketable FeRAM to other potential devices and products.

The poster presentations were divided into two sessions and well attended by participants. The symposium organizers have introduced, for the first time, “Best Poster Awards” to recognize excellent posters. The following seven posters were selected by the review panel (R. Panholzer, O. Auciello, I. Yoo, H. J. Kim and R. Ramesh) and awarded with trophies and small prizes.

07-01-P “Characterization and Electrical Properties of $\text{Bi}_{1-x-y}\text{TiSi}_x\text{YO}_z$ (BTSO) Thin Films by Atomic Layer Deposition” *Y. Min, Y.J. Cho, J. Han (SAIT, Korea) W.D. Kim, C.S. Hwang (Seoul National Univ., Korea)*

09-01-P “Reducing Azimuthal Domains in (100)- or (118)- Oriented Ferroelectric $\text{Bi}_{3.25}\text{La}_{0.75}\text{Ti}_3\text{O}_{12}$ Films Using Off-Cut Single Crystal Substrates” *S.K. Lee, N.D. Zakharov, X.H. Zhu, D. Hesse (Max-Planck-Inst., Germany) H.N. Lee, (Oak Ridge Nat. Lab., USA)*

10-23-P “Fatigue Anisotropy in Relaxor Ferroelectrics” *M. Ozgul, C. Randall, S. Trolier-McKinstry (Penn State)*

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University, USA)

01-12-P “Microstructure Characterization of Side Walls in SBT 3DCapacitors”

*N. Menou, Ch. Turquat, V. Madigou, Ch. Muller (Laboratoire Materiaux et Microelectronique de Provence, France)
D.J. Wouters, Lgoux, J. Lisoni, M. Schwiters (IMEC, Belgium) J-L. Hodeau (Laboratoire de Cristallographie, France)*

2-01-P “Comparison of In-Plane Actuation From a Thin Film and a Bulk Actuators”

E. Fribourg-Blanc, E. Cattan, D. Remiens (Université de Valenciennes, France) M. Dupont, D. Osmont (ONERA, France)

2-09-P “Piezoelectric Actuation and Micro-domain Behaviors in the Monolithically Patterned PMN-Pt Single Crystal”

B.M. Park, S.W. Ha, G.S. Lee (University of Texas, USA) S.K. Yun (Samsung Electro-Mechanics Co., Ltd., Korea)

04-05-P “Enhanced Dielectric Properties of (Ba,Sr)TiO₃ Thin Film for High-Performance Microwave Phase Shifter”

S.J. Lee, S.E. Moon, M.H. Kwak, H.C. Ryu, Y.T. Kim (ETRI, Korea)

On Wednesday, April 7, a rump session on “FeRAM – Current Status and Future Directions” was a heated forum exchanging most current activities and challenges involved in FeRAM technology and development among industrial leaders from Samsung, Infineon, Toshiba, Epson, Ramtron, and Texas Instrument. The session was chaired by Prof. Araujo and Prof. M. Okuyama and turned out to be most informative and instructive as well particularly for those in academia.

The symposium was closed with the third and final plenary lecture by K. N. Kim (Samsung) on “Future Emerging New Memory Technology” introducing PRAM and MRAM and comparing them critically with current and future FeRAM as a potential nonvolatile memory in next generation mobile electronics.

In the annual ISIF award ceremony during the conference banquet on April 7, Wednesday evening, Dr. Eiji Fujii from Matsushita Electric Co was honored with the Lifetime Achievement Award for pioneering integration processes for advanced FeRAM. Prof. W. Zhu from Technological University, Singapore, and Prof. S. Baik from POSTECH were given Outstanding Achievement Awards for contribution in promoting and sustaining interest in the field of ferroelectrics through research and education. The Corporation Innovation Awards were given to Fujitsu, Matsushita, and Ramtron.

In summary, the ISIF 2004 was unique in the sense that it was quite a satisfying occasion among all the integrated ferroelectricians around the world finally to confirm FeRAM mass-producible, sellable, reliable, and most importantly, profitable at least in smart cards. However, it is just a beginning. We have high-density embedded FeRAM coming and leading the technological basis for stand-alone FeRAM. As stated in his closing remarks by Dr. O. Auciello, who was promoted to the third member of the General Chairs of ISIF, the future of integrated ferroelectrics is bright, particularly if we broaden the statement to integrated multifunctional materials.

Finally, it is worth mentioning that the newly formed International Advisory Board of ISIF decided Shanghai as the site for the next ISIF 2005 with Professor T. A. Tang as a Technical Program Chair, and also elected Professor R. Ramesh as the Chair of the International Advisory Board.

Professor S. Baik
Technical Program Chair of ISIF 2004
Pohang University of Science and Technology (POSTECH)
e-mail: sgbaik@postech.edu

ISIF 2004 PAPERS

TUTORIALS

Piezoelectric thin films and MEMS processing

P. Muralt

Piezoelectric MEMS/NEMS devices

P. Muralt

Microscopic details of ferroelectrics

U. Waghmare

Fundamentals of ferroelectric domain and switching

I. Stolichnov

Nonvolatile memory concept — challenges and prospects

R. Waser

High K gate technology

R. Wallace

High K capacitor and recent DRAM technology

C.S. Hwang

SPM instrumentation and methodology

Sang-Il Park

Ultra high density information storage technology

Y. Cho

Nanoscale ferroelectric devices

R. Ramesh

PLENARY LECTURES

Nanoscale phenomena in synthetic functional oxide heterostructures

R. Ramesh

Technology requirements for future FRAM mass production

Kazumasa Nawata

Future emerging new memory technologies

Kinam Kim

DOMAINS AND NANOSTRUCTURES

Finite size effects and domain dynamics in ferroelectric perovskite films

P. Paruch, C. Lichtensteiger, T. Giamarchi, J.-M. Triscone, T. Tybell, J. Junquera, and Ph. Ghosez

Revisit of phase transformation kinetics in PZT thin films by sol-gel method using scanning force microscopy

BongKi Lee, Chanhyung Kim, Changdeuck Bae, Hyunjung Shin, and Seung-Hyun Kim

Imaging of ferroelectric domains in separated PTO grains by PFM

A. Roelofs, T. Schneller, K. Szot, and R. Waser

Investigation of switching behavior of ferroelectric capacitors using 3D piezoresponse force microscopy

A. Gruverman, B.J. Rodriguez, A.I. Kingon, R.J. Nemanich, and J.S. Cross

Fabrication and properties of small ferroelectric structures ('NANO-DEVICES')

I. Stolichnov, L. Malin, G. Suyal, M. Cantoni, E. Colla, R. Gysel, J. Barborowski, S. Buhlman, S. Von Allemen, S. Gentil, A. Tagantsev, P. Muralt, and N. Setter

Nano ferro-optics: Dielectric,

polarization, and optical properties in ferroelectric domains and domain walls

Lukas M. Eng

Nanoscale domains and local electromechanical hysteresis in ferroelectric films studied via scanning force microscopy

A.L. Kholkin, V.V. Shvartsman, A.Yu. Emelyanov, I.K. Bdikin, Seung-Hyun Kim, and A. Safari

Domain patterns in small ferroelectric structures fabricated by subtractive and additive methods

S. Buhlmann and P. Muralt

Formation mechanism and ferroelectric behavior of nano-domains in ultra-thin BaTiO₃ films

S. Berger and Y. Drezner

Ferroelectric field effect modulation of correlated electron behavior in colossal magnetorestrictive oxides

Charles Ahn

Analysis on ferroelectric switching behavior of PZT grains based on scanning nonlinear dielectric microscope (SNDM)

Jinhee Heo and IISub Chung

MEMS, PYROELECTRIC AND OPTOELECTRONICS: DEVICE ISSUE

Microfabrication of piezoelectric MEMS

J. Baborowski, N. Ledermann, and P. Muralt

MEMS optical switch with double vertical micromirrors

H. Fang, L. Liu, Z. Wu, N. Zhang, X. Wu, and T. Ren

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Self-actuating PZT cantilever integrated with double piezoresistive sensors for high speed atomic force microscopy
H.J. Nam, Y.S. Kim, C.S. Lee, W.H. Yin, J.U. Bu, and J.W. Hong

Design and fabrication of PZT diaphragm actuators to generate large deflections
E. Hong, S. Trolier-McKinstry, R. Smith, S.V. Krishnaswamy, and C.B. Freidhoff

Pyroelectric composites for sensor applications
B. Ploss

Pyroelectric arrays using PZT30/70 thin films with integrated radiation collectors
R.W. Whatmore, Q. Zhang, S. Landi, C.P. Shaw, P.B. Kirby

Characterization of piezoelectric shear mode inkjet actuator
Z. Zhang, and A. Grishin

A functional gradient-simulated multilayer bender actuator
S. Joeng, D. Lee, J. Koh, M. Ha, H. Choi, and J. Song

Processing and characterization of micromachined actuators based on proton-irradiated P(VDF-TrFE) copolymers
S.T. Lau, H.L.W. Chan, C.L. Choy, W.Y. Cheung, and S.P. Wong

GAS sensor application of piezo-electrically driven microtransducer nanobalance
S. Shin, S. Song, J. Paik, Naeung Lee, Jaichan Lee, and H. Park

Fully integrated high Q film bulk acoustic resonator devices with Mo/AlN/Mo structures
H. Lee, J. Park, K. Lee, Y. Ko, and J. Bu

Influence of stress on the performance of PZT thin films for microphone application
N. Zhang, Y. Yang, X. Wu, T. Ren, L. Liu, and Z. Li

OXIDES ON Si AND HIGH K DIELECTRICS

High-K gate dielectric materials issues for CMOS integration
R.M. Wallace

Epitaxial colossal magnetorestrictive/ferroelectric heterostructures on Si
A.M. Grishin, S.I. Khartsev, J.H. Kim, and J. Lu

Chemical solution deposition of hafnia and zirconia films from novel precursors
F.D. Morrison, X. Luo, M. Zhang, M. Miyake, J.F. Scott, Zoe H. Barber, T.J. Leedham, T. Tatsuta, and O. Tsuji

High-K properties of atomic-layer-deposited HfO₂ films using a nitrogen-containing Hf[N(CH₃)₂]₄ precursor and H₂O or O₃ oxidant
M. Cho, J. Park, H.B. Park, S.W. Lee, C.S. Hwang, J. Jeong, and G.H. Jang

Novel ultra-thin TiLOx alloy oxide for next generation of gate dielectric
W. Fan, S. Saha, B. Kabius, J.M. Hiller, J.A. Carlisle, O. Auciello, C. Lopez, E.A. Irene, and R. Baragiola

Variations in the electrical properties of atomic-layer-deposited Al₂O₃ thin films by various pre-oxidation treatments of the Si substrates
S.K. Kim, and C.S. Hwang

Characteristics of Pb(Zr,Ti)O₃ thin films deposited on low substrate temperature by using Ba(Mg_{1/3}Ta_{2/3})O₃ as buffer layer
I. Lin, Y. Chu, S. Lin, and K. Liu

Ferroelectric properties of Na_{0.5}K_{0.5}NbO₃ films at low temperatures
Z. Zhang, S. Khartsev, and A. Grishin

Barium titanate films fabricated by aerosol deposition method for decoupling capacitors
S. Nam, H. Yabe, H. Kakemoto, S. Wada, T. Tsurumi, and Jun Akedo

FeRAM MATERIALS - PZT SYSTEM

Electrical properties of polar-axis-oriented tetragonal Pb(Zr,Ti)O₃ films
Hiroshi Funakubo, Hitoshi Morioka, Akihiro Sumi, and Keisuke Saito

Field and temperature accelerated TDDF of PZT capacitor in FRAM
Shan Sun, Marty Depner, and Steve Traynor

Comparison and retention properties of Pb(Zr,Ti)O₃ capacitors fabricated with novel metal electrodes and their oxide compounds
Sangmin Shin, Sukpil Kim, Choong Rae Cho, June Mo Koo,

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*Sung Ho Park, Jung Hyun Lee,
Young Jin Cho, June Key Lee,
and Youngsoo Park*

Quantification of imprint effect in a ferroelectric thin film capacitor
D.P. Chu, Z.G. Zhang, P. Migliorato, E. Natori, and T. Shimoda

Imprint reversability of ferroelectric thin film capacitors due to opposite state baking
Fan Chu, Shan Sun, and Tom Davenport

Hydrothermally deposited epitaxial lead titanate thin films on strontium ruthenium oxide bottom electrode
Takeshi Morita and Yasuo Cho

Fatigue, imprint and charge retention characteristics of PZT thin films for high density FRAM devices
Seung-Hyun Kim, Chang Young Koo, Jong-Hyeon Cheon, Jung-Hoon Yeom, and Jowoong Ha

Investigation of deposition of PZT thin films by means of pulse modulated plasma jet system
Z. Hubicka, M. Cada, A. Deyneka, L. Jastrabik, G. Suchanek, and G. Gerlach

Comparison of materials for the ferroelectric thin film and the plug to be integrated into high density FeRAMs
R. Bruchhaus, B.-K. Moon, A. Hilliger, N. Nagel, G. Beitel, Y. Yamada, H. Itokawa, K. Yamakawa, and I. Kunishima

Electron backscatter diffraction micro-texture analysis of Pt and

PZT thin films for FRAM
Glen Fox, Tim Maitland, Xiaodong Han, and Mark Vaudin

Sol-gel derived lead zirconate titanate thick films
Q. Zhang, Z. Huang, and R.W. Whatmore

Effect of novel alloy bottom electrodes on ferroelectric properties of $\text{Pb}(\text{Zr,Ti})\text{O}_3$ films grown by metal-organic chemical vapor deposition
Sangmin Shin, June Mo Koo, June Key Lee, Sukpil Kim, Choong Rae Cho, Sung Ho Park, Jung Hyun Lee, Young Jin Cho, and Youngsoo Park

FeRAM MATERIALS - LAYERED PEROVSKITE

Current switching of polarization states in ferroelectric materials
Tingkai Li, and Sheng Teng Hsu

Effects of La and Nd substitutions on natural-superlattice-structured $\text{Bi}_3\text{TiNbO}_9\text{-Bi}_4\text{Ti}_3\text{O}_{12}$ thin films
Akira Shibuya, Minoru Noda, Masanori Okuyama, and Naoyuki Sugiyama

Transient current characteristics of $(\text{Bi,L a})_3(\text{Ti,V})_4\text{O}_{12}$ thin film capacitors
Hai Joon Lee, Jin Soo Kim, Sun Hee Kang, Sun Young Lee, Ill Won Kim, Jung Hyun Jeong, and Byung Chun Choi

An enhancement of ferroelectric properties in $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ thin film after both A and B sites doping
Dong Su, Yuan Yin, Jing Lou, Jun Ma, and Jinsong Zhu

Stress impact in La and Nd doped

$\text{Bi}_4\text{Ti}_3\text{O}_{12}$ thin film
X.M. Wu, W. Li, J. Ma, X.M. Lu, and J.S. Zhu

Long-term retention characteristics of 1T2C-type ferroelectric memory
Bon Jae Koo, Yusuke Hoshida, and Hiroshi Ishiwara

Characterization of $(\text{Bi,Nd})_4\text{Ti}_3\text{O}_{12}$ bi-layered perovskite ferroelectric thin films
Seaung-Suk Lee, Keum-Hwan Noh, Eung-Ryul Park, Hyeok-Je Jeong, Ji-Hye Jeong, Ji-Hye Son, Suk-Kyoung Hong, Nam-Kyeong Kim, Seung-Jin Yeom, Young-Jin Park, Hiroshi Maiwa, Takashi Hayashi, Wataru Sakamoto, Koichi Kikuta, Toshinobu Yogo, and Shin-Ichi Hirano

A new type of ferroelectric gate field effect transistor memory based on ferroelectric-insulator interface conduction
Gen Hirooka, Minora Noda, and Masanori Okuyama

MFIS structure device with a low dielectric constant ferroelectric $\text{Sr}_2(\text{Ta}_{10x}\text{Nb}_x)_2\text{O}_{27}$ formed by plasma physical vapor deposition and oxygen radical treatment
Ichirou Takahashi, Hiroyuki Sakurai, Tatsufumi Isogai, Kiyochi Funaiwa, Masaki Hirayana, Akinobu Teramoto, Shigetoshi Sugawa, and Tadahihiro Ohmi

Ferroelectric-gate field effect transistors using $(\text{Y,Yb})\text{MnO}_3/\text{Y}_2\text{O}_3/\text{Si}(111)$ structures for 1T-type FeRAMs
Koji Aizawa, Sota Kobayashi, Hiroshi Ishiwara, Kazuyuki Suzuki, and Kazumi Kato

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Influence of buffer layer thickness on the ferroelectric memory window of SrBi₂Ta₂O₉/SiN/Si structures

Jin-Ping Han, Sang-Mo Koo, Curt A. Richter, Jin-Won Park, and Eric M. Vogel

Characterization of (Bi,Ce)₄Ti₃O₁₂ thin films deposited by pulsed laser deposition

Young-Nam Oh, Woo-Seong Lee, Kyu-Jeong Choi, Soon-Gil Yoon, Min Ku Yeon, Seong Ihi Woo, and Chae-Ryong Cho

Defect structure in undoped and donor-doped polycrystalline Sr₂Bi₄Ti₅O₁₈

Wang-Ping Lu, Rong Hui, and Xiao-Bing Chen

Novel (Y,Yb)MnO₃ thin films for FeRAM application

Kzuyuki Suzuki, Kiyotaka Tanaka, Desheng Fu, Kaori Nishizawa, Takeshi Miki, and Kazumi Kato

FeRAM PROCESS INTEGRATION

Ultra-dense 3D FeRAMs

C.A. Paz de Araujo and J. Chen

Integrated technologies for high density FeRAMs and their challenges for 130nm regime and beyond

I. Kunishima and G. Beitel

SBT integration for stack cell FeRAM

V. Joshi

Preparation of Pb(Zr_xTi_{1-x})O₃ films on trench structure for high-density ferroelectric random access memory

Y. Park, C.R. Cho, J.M. Koo, S. Shin, J.K. Lee, S.P. Kim, S.H. Park, J.H. Lee, and Y.J. Cho

Enhanced retention properties for highly reliable and manufacturable FRAM device

Y.J. Song, H.J. Joo, S.K. Kang, H.H. Kim, J.H. Park, Y.M. Kang, E.Y. Kang, S.Y. Lee, and K. Kim

Process integration technologies for 16Mb 1T1C FeRAM

Suk-Kyoung Hong

Key integration issues for silicon-based ferroelectric thin film devices

T.L. Ren, L.T. Liu, and Z.J. Li

Ferroelectric properties and reliability of sidewall SBT in integrated 3D FECAPS

L. Goux, Var, J. Lisoni, M. Schwitters, V. Paraschiv, D. Maes, X. Zhen, B. Kaczer, L. Haspeslagh, D.J. Wouters, N. Menou, C. Muller, C. Caputat, and R. Zambrano

Integration of MOCVD SBT stacked ferroelectric capacitors in a 0.35 μm CMOS technology

D. Maes, J.-L. Everaert, L. Goux, J. Lisoni, V. Paraschiv, M. Schwitters, L. Haspeslagh, D.J. Wouters, C. Artoni, C. Caputa, P. Casella, G. Corallo, G. Russo, R. Zambrano, H. Monchoix, and L. Van Autryve

Ferroelectric properties of (Bi,La)₄Ti₃O₁₂ thin film deposited by pulsed-DC sputtering method in merged top-electrode and plate-line structure

S.Y. Kweon, N.K. Kim, S.J. Yeom, E.S. Choi, H. J. Sun, J.S. Roh, S.H. Oh, K.D. Ban, J.W. Park,

G.D. Park, J.G. Kim, J.Y. Seong, K.H. Noh, H.B. Kang, H.J.

Jeong, D.Y. Jeong, J.Y. Lim, J.H. Son, K.H. Bang, S.H. Park, K.N. Lee, S.S. Lee, S.K. Hong, H.C. Sohn, Y.J. Park, and J.W. Kim

Process and substrate effects on the properties of MOCVD-deposited SrBi₂Ta₂O₉ films

M. Schwitters, J.-L. Everaert, J. Lisoni, V. Paraschiv, L. Goux, D.J. Wouters, H. Monchoix, C. Caputa, and R. Zambrano

Profile and etch characterization of high water temperature etched Y1/Pt stacks

S. Marks and J.P. Almerico

CVD/ALD PROCESSING

A novel showerhead-free MOCVD system for deposition of ferroelectric and dielectric oxide films

M. Brubaker, P. Mumbauer, and R. Grant

Atomic layer deposition of SrTiO₃ films having a high thickness and cation composition conformality over a severe contact hole structure

On Seong Kwon, Moon Ju Cho, Cheol Seong Hwang, and Jae Hack Jeong

C-oriented MOCVD YMn₃ thin film and its electrical characteristics in MFIS 1-T FeRAM

Daesig Kim, David Klingensmith, David Dalton, Klaus Dimmler, Viorel Olariu, Fred Gnadinger, T.S. Kalkur, Ali Mahmud, and Mosiur Rahman

Capability of MOCVD based deposition technologies for next

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generation device structures and remaining challenges for the introduction into large scale manufacturing

M. Schumacher, J. Lindner, P.K. Baumann, P. Lehnen, S. Miedl, C. Lohe, and T. McEntee

Fabrication of $\text{Pb}(\text{Zr},\text{Ti})_3$ thin films by liquid delivery MOCVD using a cocktail source with $\text{Pb}(\text{DPM})_2$, $\text{Zr}(\text{MMP})_4$ and $\text{Ti}(\text{MMP})_4$

Yohai Otani, Soichiro Okamura, and Tadashi Shiosaki

Laser treatment of ultra-thin TiO_2 films grown by plasma-enhanced atomic layer deposition

Jeon-Ho Kim, Kyu-Jeong Choi, Son-Gil Yoon, Jin-Dong Kim, and Won-Jae Lee

Comparative study on the nano-mixed $\text{Hf}_x\text{Al}_y\text{O}_z$ and $\text{HfO}_2/\text{Al}_2\text{O}_3$ laminate thin films prepared by ALD process for the application to DRAM capacitor

Deok-Sin Kil, Kwon Hong, Jae-Sung Roh, Hyun-Cheol Son, Jin-Woong Kim, Young-Ho Lee, and Ki-Young Oh

Thickness dependent characteristics in the growth of $\text{Pb}(\text{Zr}_{0.4}\text{Ti}_{0.6})\text{O}_3$ thin films on LaNiO_3 electrode by MOCVD

Shih-Sian Huang, Jin-Li Lia, and Tai-Bor Wu

Preparation of Ir-based electrodes for PZT capacitors by MOCVD using a novel Ir precursor

H. Fujisawa, S. Watari, M. Shimuzu, H. Niu, and N. Oshima

MOCVD of PZT and Ir thin films for ferroelectric memories

M. Shimuzu, H. Nonomura, S. Watari, H. Fujisawa, H. Niu, K. Honda, and N. Oshima

64Mb embedded FeRAM arrays: Reliability and manufacturing of MOCVD $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$ thin film capacitors

S. Aggarwal, A. Thomas, J.S. Martin, J. Urquhart, F. Celii, L. Hall, J. Rodriguez, K.R. Udayakumar, S.R. Summerfelt, T.S. Moise, K.J. Taylor, R. Bailey, and G. Fox

Very thin TiO_2 films prepared by plasma enhanced atomic layer deposition (PEALD)

J. Park, W. Lee, G. Lee, I. Kim, B. Shin, and S. Yoon

The effect of iridium bottom electrode on the characteristics of $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$ films grown by MOCVD method

B. Bae, K. Lee, S. Nam, K. Park, J. Lim, C. Lee, S. Park, U. Chung, and J. Moon

Thickness downscaling of $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$ films by sub-100nm at low deposition temperature by metalorganic chemical vapor deposition

Atsushi Nagai, Hitoshi Morioka, Gouji Asano, Atsushi Saiki, and Hiroshi Funakubo

Improvement in reliability of 0.25 μm 1F2 cell FRAM by using novel MOCVD PZT technology

H.J. Joo, Y.J. Song, H.H. Kim, J.H. Park, Y.M. Kanf, S.Y. Lee, and K. Kim

MULTI-FERROICS AND GRADED FERROELECTRICS

Offsets in graded ferroelectric films
R. Bouregba, G. Poullain, B. Vilquin, and G. Le Rhun

Relaxor superlattices. Ordered-disordered control of B-site ions
Hitoshi Tabata

Tri-color superlattices with compositionally broken inversion symmetry grown by pulsed laser deposition
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Properties of ferroelectrics materials applicable to tunable microwaves device

J.-S. Kim, J.S. Choi, B.H. Park, T.J. Choi, S.H. Shin, J.C. Lee, M.J. Lee, S.A. Seo, I.K. Yoo, J.K. Lee, and H.J. Choi

CIRCUIT DESIGN AND ARCHITECTURE

Fabrication of 1K-bit 1T2C-type ferroelectric memory cell array

S. Yamamoto, H. Kim, H. Ishiwara, K. Aaizawa, T. Ishikawa, T. Fuchikami, B. Park, T. Furukawa, H. Ohki, S. Kikuchi, and H. Hoko

Improvement of data readout disturbance effects in 1T2C-type ferroelectric memory array

H. Kim, S. Yamamoto, and H. Ishiwara

Application of metal-ferroelectric-insulator-semiconductor field-effect transistors (MFIS-FETS) in non-volatile logic integrated circuits

Y. Xie, Y. Lin, and T. Tang

A novel chain FRAM with driven plate read scheme

L. An, T. Ren, C. Wei, X. Wang, and L. Liu

Word line voltage generator circuit for ferroelectric random access

memory

Y.S. Yang, B.G. Yu, and J. Kim

Conductive metal oxide thin film ferroelectric memory transistor

T. Li, S.T. Hsu, B. Ulrich, and D. Evans

Graphic solution method and analysis of voltage distribution between ferroelectric capacitor/capacitors and bitline capacitance

C. Wei, T. Ren, J. Zhu, and L. Liu

MODELING AND THEORY

Vibronic interactions, and the phase transitions of hydrogen-bonded ferroelectrics

N.D. Dalal, S.P. Gabuda, and S.G. Kozlova

Structure model of atoms behavior in B-site disordered perovskite ferroelectrics with relaxor properties

Alla R. Lebedinskaya and Mikhail F. Kupriyanov

A ferroelectric capacitor mathematical model for spice simulation

Chao-Gang Wei, Tian-Ling Ren, Jun Zhu, and Li-Tian Liu

Imaginary time Schroedinger treatment for microstructure modeling in ferroelectrics

E. Klotins, V. Shvartsman, I. Bdikin, and Kholkin

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Tae-Young Lim, Ki-Ho Yang,

Byong-Ho Kim, and Keun-Ho Auh

Multibit operation of MFISFET with $\text{Pt/SrBi}_2\text{Ta}_2\text{O}_9/\text{Y2O}_3/\text{Si}$ gate structure

Sun Il Shim, Young Suk Kwon, Ik Soo Kim, Seong-Il Kim, Yong Tae Kim, and Jung Ho Park

Two evidences for enlargement of remnant polarization in vanadium-doped $\text{Bi}_4\text{-Ti}_3\text{O}_{12}$

Xiang-Yu Mao, Jun Zhu, and Xiao-Bing Che

Strontium barium bismuth titanate layered perovskites: Ferroelectric thin film preparation and characteristics

Dan Xie, Tianling Ren, and Litian Liu

The effect of substrate materials on orientation degree of lanthanum-substituted bismuth titanate thin films

Dan Xie, Tianling Ren, Litian Liu

Electrical characterization of $\text{Bi}_{40x}\text{La}_x\text{Ti}_3\text{O}_{12}$ ferroelectric thin films formed by sol-gel method

Hochan Ham, Isub Chung, Suk-Kyoung Hong, Hai Joon Lee, Sun Young Lee, and Ill Won Kim

Polarization characteristics of high valence ion doped bismuth lanthanum titanate ceramics

Jin Soo Kim, Sun Hee Kang, Hai Joon Lee, Sun Young Lee, and Ill Won Kim

Crystal structure analysis of $\text{Bi}_{3.5}\text{Ce}_{0.5}\text{Ti}_3\text{O}_{12}$ using neutron powder diffraction and Raman spectroscopy

Min Ku Jeon, Ki Woong Kim, Tai

ISIF 2004 PAPERS

Suk Kim, Seong Ihl Woo, Yong-Il Kim, and Hyun Jin Chung

The lanthanide ions doping effects on the electrical properties of $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ thin films fabricated on silicon substrates

Ju Cheul Bae, Sang Su Kim, Moon Heum Park, Hyun Ju Kim, Tae Gon Ha, Ho Sueb Lee, Won-Jeong Kim, Ki Wan Jang, Tae Kwon Song, and Jae-Sung Song

Ferroelectric property of $\text{MBi}_4\text{Ti}_4\text{O}_{15}$ (M=Sr,Ca,Pb) thin films

Wen Xu, Xian Yu, and Wan In Lee

Ferroelectric characteristics of the MOD-derived

$\text{Sr}_x\text{Bi}_{2.4}(\text{Ta}_{0.75}\text{Nb}_{0.25})_2\text{O}_9$ (SBTN) thin film and electrical properties of the Pt/SBTN/ TiO_2 /Si structure

J.H. Choi, K.Y. Lee, and T.S. Oh

Growth and ferroelectric characterizations of cerium-modified bismuth titanate thin film deposited on gan substrate by pulsed laser deposition

Jae-Yeol Hwang, Chae-Ryong Cho, Sang-A Lee, Se-Young Jeong, and Soon-Gil Yoon

The combinatorial search of novel ferroelectric material for FRAM capacitor using liquid source misted chemical deposition (LSMCD) process

Ki Woong Kim, Min Ku Jeon, Tai Suk Kim, and Seong Ihl Woo

Effects of complex alkoxide solutions on crystallization of ferroelectric $\text{CaBi}_4\text{Ti}_4\text{O}_{15}$ thin films

Naoto Togashi, Takayuki Mogi, Masayoshi Hochido, and Kazumi

Kato

Dielectric and ferroelectric properties of dy-doped $\text{Sr}_2\text{Bi}_4\text{Ti}_5\text{O}_{18}$ ceramics

Feng Qiang, Wang-Ping Lu, Jun Zhu, and Xiao-Bin Chen

Crystallographic orientation dependent ferroelectric characteristics of $(\text{Bi,L a})_4\text{Ti}_3\text{O}_{12}$ (BLT) capacitors

N.-K. Kim, S.-Y. Kweon, E.-S. Choi, H.-J. Sun, K.-D. Ban, J.-W. Park, J.-H. Sun, G.-D. Park, J.-H. Son, H.-J. Jeong, E.-R. Park, K.-H. Noh, D.-Y. Jeong, J.-Y. Lim, H.-B. Kang, K.-Y. Bang, S.-C. Park, J.-Y. Seong, J.-G. Kim, S.-H. Oh, S.-H. Park, K.-N. Lee, S.-S. Lee, S.-K. Hong, S.-J. Yeom, J.-S. Roh, H.-C. Sohn, Y.-J. Park, and J.-W. Kim

Effect of ferroelectric switching characteristics on fatigue behavior of $(\text{Bi,L a})_4\text{Ti}_3\text{O}_{12}$ thin films

Nam-Yeal Lee, Sung-Min Yoon, Woong-Chul Shin, Sang-Ouk Ryu, Byoung-Gon Yu, and Won-Jae Lee

Structural and ferroelectric properties of $\text{Bi}_{4-x}\text{Y}_x\text{Ti}_3\text{O}_{12}$ films

J. Ma, Y. Ying, X.M. Wu, D. Su, X.M. Lu, and J.S. Zhu

Formation of ferroelectric $(\text{Bi,Nd})_4\text{Ti}_3\text{O}_{12}\text{S}$ thin films on $\text{HfO}_2/\text{Si}(100)$ structures for MFIS-type ferroelectric memory application

Y. Tabuchi, K. Takahashi, H. Ishiwara, B.E. Park, K. Kato, and Y. Arimoto

Al_2O_3 hydrogen barrier encapsulation layer FeRAM

B.Y. Tan, K. Iseki, H. Ishiwara,

H. Ohki, and Y. Fujisaki

Dielectric properties of lanthanum-doped bismuth layer-structured ferroelectrics

Rong Hui, Jun Zhu, Wang-Ping Lu, and Xiao-Bing Chen

Microstructure and electrical properties of BLT films by chemical solution deposition

S. Kang, J.K. Lee, and J.W. Park

Imprint characteristics of $(\text{Bi,L a})_4\text{Ti}_3\text{O}_{12}$ -layered perovskite ferroelectric thin films

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Electrical properties of Pt/ $\text{SrBi}_2\text{Ta}_2\text{O}_9/\text{HfO}_2/\text{Si}$ structures for a 1T-type ferroelectric memory

K. Takahashi, H. Ishiwara, and B.E. Park

Metal-ferroelectric-insulator-semiconductor (MFIS) FET's using $\text{LiNbO}_3/\text{AlN}/\text{Si}(100)$ structures for nonvolatile memory applications

Soon-Wo Jung, Sang-Hyun Jeong, Yong-Seong Kim, Yong-Il In, Wan-Seop Kim, Yong-Jun Ban, Young-Kil Kim, Kwang-Ho Kim, and Kwangsoo No

X-ray characterization and domain structure of high-quality $\text{SrBi}_2\text{Ta}_2\text{O}_9$ single-crystals grown by self-flux solution method

H. Amorin, I.K. Bdikin, V.V. Shvartsman, M.E.V.

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*Costa, A.L. Kholkin, A. Almeida,
and M.R. Chaves*

Effects of bottom electrodes on physical and electrical properties of $(\text{Bi,Lu})_4\text{Ti}_3\text{O}_{12}$ (BLT) thin films
N.-K. Kim, S.-Y. Kweon, E.-S. Choi, H.-J. Sun, K.-D. Ban, J.-W. Park, J.-H. Sun, G.-D. Park, J.-H. Son, H.-J. Jeong, E.-R. Park, K.-H. Noh, D.-Y. Jeong, J.-Y. Lim, H.B. Kang, K.-Y. Bang, S.-C. Park, J.-Y. Seong, J.-G. Kim, S.-H. Oh, S.-H. Park, K.-N. Lee, S.-S. Lee, S.-K. Hong, S.-J. Yeom, J.-S. Roh, H.-C. Sohn, Y.-J. Park, and J.-W. Kim

Ferroelectric property dependence on the texture of $\text{SrBi}_2\text{Ta}_2\text{O}_9$ thin films

Shuren Zhang, Jingsong Liu, Fugui Chen, Zhaoming Tian, and Chengtao Yang

Fatigue melioration of neodymium-modified $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ ceramics

W. Li, C.J. Wang, X.M. Lu, and J.S. Zhu

Mechanical and dielectric relaxation in neodymium-modified bismuth titanate ceramics

Wei Li, Dong Su, Jinsong Zhu, and Yening Wang

Characterization of $\text{Bi}_{3.25}\text{La}_{0.75}\text{Ti}_3\text{O}_{12}$ thin films prepared on thermally oxidized N-type silicon substrates

Eunjung Ko, Jaemoon Pak, Kuangwoo Nam, and Gwangseo Park

The preparation of a fatigue-free $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ thin film with controlling Bi-excess using sol-gel method

Wenxu Xianyu, T. Ko, and W.I.

Lee

Sol-gel derived $\text{Bi}_{4-x}\text{Nd}_x\text{Ti}_3\text{O}_{212}$ bi-layered perovskite ferroelectric thin films

Ik Soo Kim, Woo Sik Kim, Sun Il Shim, Yong Tae Kim, and Young Hwan Kim

Effect of excess bismuth in ferroelectric properties of

$\text{Bi}_{4-x}\text{Nd}_x\text{Ti}_3\text{O}_{12}$ thin films

Young Mi Kim, Ik Soo Kim, In-Hoon Choi, Woo Sik Kim, Young Tae Kim, and Young Hwan Kim

Effects of bottom electrode conditions on characteristics of BLT capacitors

Taekwan Oh, Jinwoo Lee, and Jiyoung Kim

Ferroelectricity Newsletter

including all back issues is available on Internet

<http://www.sp.nps.navy.mil/projects/ferro/ferro.html>

in Adobe Acrobat PDF file format

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mail: Hannah Liebmann

500 Glenwood Circle #238, Monterey, CA 93940-4724 USA

300TH VOLUME OF FERROELECTRICS

300TH VOLUME OF FERROELECTRICS

The 300th Volume of FERROELECTRICS, the international journal devoted to the theoretical, experimental, and applied aspects of ferroelectrics and related materials, has just published its 300th volume. In his editorial, George W. Taylor writes, "It seems only a short time since I was writing an Editorial to commemorate the publication of the 200th Volume of FERROELECTRICS. Now we have reached the 300th volume. The first 100 volumes were published over a period of twenty years, the second 100 volumes took nine years to publish, while the third 100 volumes were published in less than seven years. FERROELECTRICS, since it began publication in 1970, has published more than 10,000 peer reviewed papers covering all aspects of the theory, fabrication, properties and applications of ferroelectrics and related materials.

"The rapid growth of the journal FERROELECTRICS is a reflection of the ever growing importance of ferroelectricity and related phenomena from a basic understanding of the physics of a very large and significant groups of materials to their many engineering applications. FERROELECTRICS continues to be the preeminent international archival journal in the field.

"All of us in the field agree that the years ahead for ferroelectrics are going to be very exciting as new materials, new properties, new theories and new devices and applications are discovered and developed. The Editors, the Editorial Board and the Publisher of FERROELECTRICS are committed to continuing to provide a scientific journal of the highest excellence that fulfills the needs of the international scientific community."

The following is a list of titles and authors of the articles published in the 300th volume.

Morphotropic phase transitions in mixed sodium-potassium niobate systems

Vijendra Lingwal and N.S. Panwar

Investigation of the soft mode of $SbSBr_xI_{1-x}$ crystals

A. Audzijonis, L. Zigas, J. Siroicas, J. Narusis, R. Zaltauskas, A. Cerskus, and R. Sadzius

A study of the incommensurate phase of Rb_2ZnCl_4 by ESR

M. Agirtmis, H.A. Farach, R.J. Creswick, and C.P. Poole, Jr.

Physical kinetics of ferroelectric hysteresis

S. Sivasubramanian, A. Widom, and Y.N. Srivastava

Kinetics of domain nucleation in ferroelectric $Ba_5Ti_2O_7Cl_4$

S.G. Ingle and N.M. Patil

Dielectric study of the phase transitions in $Pb_{1-x}Ba_x(Yb_{1/2}Ta_{1/2})O_3$ ceramics

Dibyanjan Rout, V. Subramanian, K. Hariharan, V. Sivasubramanian, and V.R.K. Murthy

Low frequency dielectric relaxation, spontaneous polarization, optical tilt angle and response time investigations in a fluorinated ferroelectric liquid crystal, $N125F2(R^*)$

D.M. Potukuchi, A.K. George, C. Carboni, S.H. Al-Harathi, and J. Naciri

The visualization of micro-domains in semi-crystalline ferroelectric polymers

Guodong Zhu and Jie Li

Dielectric properties of solid solutions based on ferroelectric-antiferromagnetic $BiFeO_3$ over the microwave range

Yu.A. Shevchuk, V.V. Gagulin, S.K. Korchagina, and V.V. Ivanova

Influence of axial pressure on electric properties of $Na_{0.5}Bi_{0.5}TiO_3$ - $PbTiO_3$ system

J. Suchanicz, R. Rosiek, J.P. Mercurio, and S. Said

Paraelectric-antiferroelectric phase coexistence in the deuteron glass $Rb_{0.5}(ND_4)_{0.5}D_2AsO_4$

S. Lanceros-Mendez, V.H. Schmidt, and S.A. Shapiro

Theory of electric field influence on phase transition in glycine

UPCOMING MEETINGS

phosphite

I. Stasyuk and O. Velychko

Time-domain terahertz spectroscopy of SrBi₂Ta₂O₉

Petr Kuzel, Alexey Pashkin, Martin Kempa, Filip Kadlec, Stanislav Kamba, and Juan Petzelt

Phase-transition and dynamics of hexatic ferroelectric liquid crystals

I. Rychetsky, M. Glogarova, and V. Novotna

Ab initio calculation of piezoelectric and ferroelectric properties of NaNO₂

Y. Noel, M. Catti, and R. Dovesi

Effect of ECR plasma treatment on lithium niobate surface state

L. Kokhanchik, E. Yakimov, and S. Shapoval

Phase diagrams for ferroelectric-antiferroelectric mixed systems

N.A. Korynevskii and O.R. Baran

Critical dynamics in BCPS at the N-IC phase transition

Dieter Michel, Abdoulaye Taye, and Jörn Petersson

Dielectric properties of Rb₂CdBr₄ and Rb₂HgBr₄

Fuminao Shimizu and Masaaki Takashige

The investigation of dynamic piezoelectric properties of Sn₂P₂S₆ single crystals

Yu. Tyagur, L. Burianova, I. Tyagur, A. Kopal, and P. Hana

Simulation of the polarization switching in ferroelectrics with dipolar defects through the Landau-theory-based lattice model

J.P. Rino, A. Picinin, M.H. Lente, and J.A. Eiras

Guide to the literature of piezoelectricity and pyroelectricity. 21

Sidney B. Lang

2004 MRS Fall Meeting
29 November - 3 December 2004
Boston, Massachusetts, USA

The 2004 MRS Fall Meeting will serve as a key forum for discussion of interdisciplinary leading-edge materials research from around the world. Various meeting formats—oral, poster, round-table, forum and workshop sessions—are offered to maximize participation.

Symposia are offered in the following disciplines:

- Electronics, magnetics, and photonics
- Materials for energy generation and storage
- Advances in materials characterization
- Mechanical behavior
- Hybrids and soft matter
- Novel materials fabrication and applications
- Materials topics of general interest

Symposium Tutorial Program

Available only to meeting registrants, the symposium tutorials will concentrate on new, rapidly breaking areas of research

Exhibit and Research Tools Seminars

A major exhibit encompassing the full spectrum of equipment, instrumentation, products, software, publications, and services is scheduled for 30 November - 2 December in the Hynes Convention Center, convenient to technical session rooms. Research Tools Seminars, and educational seminar series that focuses on the scientific basis and practical application of commercially available, state-of-the-art tools will be held again this fall.

Contact: www.mrs.org/meetings/

UPCOMING MEETINGS**The 17th Annual Symposium on Integrated Ferroelectrics (ISIF 2005)****17-20 April 2005****Shanghai, China**

The science and technology of ferroelectric thin films and their application have attracted many researchers and experienced tremendous progress in recent years. The worldwide increase in commercial applications of them is a symbol of both the maturity and the acceptance of the technology. The field of ferroelectric/piezoelectric/high-K dielectric/phase change materials is still growing rapidly because of the potential application in MEMS technologies and the development of new generations of nonvolatile memory devices. The recent interest in the high-K gate dielectrics have made the science and technology of ferroelectric thin film more attractive.

This symposium aims to provide a forum for presentation and discussion of the state-of-the-art of those topics as memory materials and devices, pyroelectric sensors, electro-optical components, nano-technology theory, *ab-initio* calculations, and the research and exploitation of nano-size effects.

Topics

- High-frequency devices
- High-K gate dielectrics and electrodes
- Integrated sensors
- Modeling, simulation, theory, and *ab-initio* calculations
- Circuits and devices
- Device integration issues
- FeRAMs, DRAMs and materials
- Ferroelectrics for space application
- 1T-cell field effects nonvolatile memory devices
- Graded or superlattice ferro devices
- Domain dynamics and engineering
- Nano-structure and nano-size effects
- Nonvolatile memory applications
- Piezoelectric and MEMS application
- Pyroelectric/IR and optical applications
- Phase change memory technology
- CMR and charge ordering materials and devices
- Testing and characterization
- Other thin films and their applications

Technical Program Chairs

Ting-Ao Tang (Fudan University), S. Narayan (Symetrix), S. Baik (Postech), Sandwip K. Dey (Arizona State U.)

Contact

Kerry Baugh, Symposium Coordinator, University of Colorado at Colorado Springs
1420 Austin Bluffs Parkway, P.O. Box 7150, Colorado Springs, CO 80933-7150 USA
kerry@isif.net + (719)598-2285

Huihua Yu, Symposium Coordinator, Fudan University
220 Handan Road, Shanghai, 200433, China
hhyu@fundan.edu.cn +8621-6564-3761 +8621-6564-8267 (fax)

Space Systems Academic Group
Code SP
Bullard Hall, Bldg. 233, Room 125
Naval Postgraduate School
Monterey, CA 93943 USA

Spring/Summer 2004

Ferroelectricity Newsletter

CALENDAR OF EVENTS 2004

Sep 6-9 • 7th European Conference on Applications of Polar Dielectrics (ECAPD7), Liberec, Czech Republic (see *Ferroelectricity Newsletter*, Vol. 12, No. 1, p. 14)

Oct 17-22 • Introduction to Polymeric Adhesives and Composites, ACS short course, Blacksburg, Virginia, USA (see *Ferroelectricity Newsletter*, Vol. 12, No. 1, p.13)

Nov 4-5 • Frontiers in Inorganic Polymers, ACS short course, Philadelphia, Pennsylvania, USA (see *Ferroelectricity Newsletter*, Vol. 12, No. 1, p.13)

Nov 29-
Dec. 3 • 2004 MRS Fall Meeting, Boston, Massachusetts, USA (see p. 26)

Dec 5-10 • Polymer Chemistry: Principles and Practice, ACS short course, Blacksburg, Virginia, USA (see *Ferroelectricity Newsletter*, Vol. 12, No. 1, p. 13)

2005

Apr 17-20 • The 17th Annual Symposium on Integrated Ferroelectrics (ISIF 2005), Shanghai, China (see p. 27)