
Ferroelectricity Newsletter

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

Volume 1, Number 2

Spring 1993

RESPONSE TO THE FIRST ISSUE AND PLANS FOR THE FUTURE

We are pleased to report that the feedback we received on the first issue of the *Ferroelectricity Newsletter* is very encouraging. It seems that all the people who were involved in getting this project underway read the pulse of the time correctly: this publication really fills a need in the scientific community of ferroelectrics.

Requests for copies came from different parts of the country, both from industry and academia. One letter asking for the *Ferroelectricity Newsletter* reached us from the University of Duisburg in Germany. Prof. Kleemann, head of the Physics Department, heard about the publication from Dr. Wallace Smith at the February MIT/ONR Meeting on Ferroelectricity in Williamsburg, VA.

We encourage you to **copy and distribute the newsletter** to people who might profit from it. Also, back issues are available for the asking. Organizers of conferences on ferroelectrics might want to distribute the newsletter at these meetings. Let us know if you want to take advantage of this service.

The *Ferroelectricity Newsletter* can also act as a **clearing house for coordinating dates of conferences**. This April the conference of the American Ceramic Society coincides with the ISIF 93. If we use available channels of communication, such as this newsletter, we might be able to avoid those occurrences in the future.

The list of professional societies we promised to publish in this issue will be included in the Summer 93 newsletter. In it you will also find detailed information on *Ferroelectrics*, Volume 135, Numbers 1-4 (1992), a special issue on dielectric properties of ferroelectrics dedicated to Prof. Arthur R. von Hippel on the occasion of his 94th birthday.

The Summer 93 issue will also contain a **survey of patents** in the field of ferroelectricity. We ask for your input to this article.

As we mentioned before, we are **interested in your feedback**. Please contact us if you need further information on any item in this newsletter.

Rudolf Panholzer
Editor-in-Chief

IN THIS ISSUE

From the editor	1
Patent report	
Ferroelectric RAM	2
Conference report	
Fall 1992 MRS meeting	3
Proceedings	
ISAF 92 poster sessions	2
ISAF 92 papers	4
Scientific journals	
From Gordon and Breach	10
Upcoming meeting	
Nonvolatile memory technology review	11
Calendar of events	12

Ferroelectricity Newsletter

Volume 1, Number 2
Spring 1993

The *Ferroelectricity Newsletter* is published quarterly by the Naval Postgraduate School, Space Systems Academic Group, Monterey, California, with the support of the Defense Advanced Research Projects Agency (DARPA) and the Office of Naval Research (ONR).

Prof. Rudolf Panholzer
Editor-in-Chief
Dr. Hannah Liebmann
Managing Editor

Please direct inquiries to
Hannah Liebmann
500 Glenwood Circle, Suite 238
Monterey, CA 93940-4724
Phone (408) 649-5899
Fax (408) 655-3734

© 1992 NPS Space Systems Acad. Group

PATENT REPORT

ISAP 92 POSTER SESSIONS

There were five poster sessions at the 8th International Symposium on the Application of Ferroelectrics:

1. Ferroelectric
2. Thin Films
3. Dielectric
4. Piezoelectric, Electrostrictive
5. Electrooptic, Pyroelectrics, Photorefractive

The following is a list of the titles and authors.

1. FERROELECTRIC

New Ferroelectric $Ba_{1-x}M_x(Li_{2x}Al_{2-2x})O_{4-4x}F_{4x}$ (M=Pb, Sr)

S.-Y. Huang, R. Von Der Mühll, J. Ravez, and P. Hagemuller

Optical Characteristics of $Pb_5Al_3F_{19}$ -Type Crystals

R. Von Der Mühll, J. Ravez, V. Andriamampianina, J. P. Chaminade, and A. Simon

Poling and Switching Behavior of Ferroelectric Single Grains Studied by Piezoelectric Resonance

Y. I. Ryu, J. S. Kim, and I. Yu

The Influence of La Content in PLZT-x/95/5 Ceramics (x=0.5 to 4%) on the Dielectric, Pyroelectric, Thermally Stimulated Current and Raman Scattering Measurements and Model Interpretation

J. Handerek, Z. Ujma, D. Dmytrow, C. Carabatos-Nedelec, and I. El-Harrad

Processing and Characterization of New Members of Pb-K-Niobate Series

P. Janna, V. A. Kallur, M. A. Drummond, S. Nigli, and R. K. Pandey

Pyrochlore/Perovskite Phase Transformation in Lead Zinc-Niobate Based Ceramics

X. Wang and X. Yao

continued on page 3

FERROELECTRIC RAM DEVELOPED

The *NAVY DOMESTIC TECHNOLOGY TRANSFER Fact Sheet*, Volume 17, Number 3, Item 4, March 1992, contains the backup documentation for a patent on a nonvolatile ferroelectric memory cell developed by the Naval Surface Warfare Center.

Summary of the invention

“The present invention relates to a nonvolatile ferroelectric dynamic RAM memory using a ferroelectric storage capacitor having hysteresis states corresponding to logic states in a manner wherein there are no half-selects for read or write addressing. The ferroelectric capacitor is written to with a charging voltage and the capacitor retains the hysteresis state even after the charge has dissipated. The read is accomplished by application of a voltage sufficient to switch one of the hysteresis states which requires a charging current. The resulting current from the read voltage will be different for each of the two hysteresis states.” (p. 3)

What problems does it solve and how?

The ferroelectric RAM is a nonvolatile, radiation hardened memory. It can be turned off without the loss of data. It takes less power than a DRAM, can have comparable density, and can be made radiation hardened. Its principle uses are for space and strategic applications. It may eventually become cheap enough for application in home computers.

Main advantages

Low cost, fast read and write, nonvolatile, light-weight, low-power, small volume.

Production information

Concept has been proven, although better ferroelectric materials are being developed.

Contact

Dahlgren Division Detachment White Oak
Naval Surface Warfare Center
Ramsey D. Johnson, Code D4T,
10901 New Hampshire Ave., Silver Spring, MD 20903-5000
Phone (301) 394-1505, DSN 290-1505

<p><i>Integrated Ferroelectrics</i>, Volume 2, Numbers 1-4 (1992) contains the second part of two parts of the Proceedings of the Third International Symposium on Integrated Ferroelectrics held in Colorado Springs, CO, 3-5 April 1991. See page 10 of this newsletter on how to contact the Editor-in-Chief George W. Taylor.</p>
--

CONFERENCE REPORT

FALL 1992 MRS MEETING

Symposium G: Amorphous insulating thin films

The following article summarizes some of the ferroelectric papers given at the Fall 1992 MRS meeting in Boston from 30 Nov to 4 Dec 1992. The symposium "Amorphous insulating thin films" was organized by J. Kanicki, W.L. Warren, R.A.B. Devine, and M. Matsumura.

New and exciting analytical techniques are being used to understand the intrinsic material properties of ferroelectrics on an atomic scale. Some of the techniques discussed at the 1992 Fall MRS meeting include electron holography, electron paramagnetic resonance (EPR), and photothermal deflection spectroscopy (PDS). Further, innovative device designs, and associated experiments provide insight to ferroelectric behavior.

Electron holographic characterization of ferroelectrics, a technique employed by Zhang and Joy at the University of Tennessee, was shown to have the capability to probe the ferroelectric domain walls, field distributions, and provide a quantitative measure of the domain wall width and local polarization state in single crystal BaTiO₃. They have also been able to use this technique to visualize charge singularities within the domain wall. It was suggested that these charge singularities arise from oxygen vacancies. If so, holographic characterization of thin film ferroelectrics may be of great importance in our understanding of this important point defect and its relationship to fatigue, aging, and imprint phenomena.

Further characterization of intrinsic defects in PLZT and PZT ceramics was carried out by the combined EPR/PDS measurements by researchers at Sandia National Laboratories. Seager, Warren, Tuttle, and coworkers have used these techniques to identify two charged point defects in ultra-violet illuminated PLZT: holes trapped at Pb⁺² corner sites and electrons trapped at the central Ti⁺⁴ sites in the perovskite lattice. It appears as though these centers are the shallow hole and electron traps, respectively.

On the electrical characterization front, it was demonstrated by Makita et al at Mitsubishi Electric Corporation that the dc current and dielectric constant are strongly coupled to material properties of the ferroelectric, such as film microstructure and grain size. In these Ba(Sr)TiO₃ thin films, it was shown that the leakage current increases as the film structure changes from granular to columnar; it was also found that the dielectric constant increases with grain size.

The electrical properties of BaTiO₃ thin films were investigated with differing device structures by Jia et al at the State University of New York at Buffalo. It was found that a reasonable compromise with respect to the leakage current and dielectric constant can be achieved if a polycrystalline/amorphous ferroelectric stack is used.

Last, it appears that by the year 2000, if SiO₂ is still the primary dielectric for devices such as DRAMs, its thickness will have to be reduced to 0.4 nm (anything thinner than 0.3 nm will be unsuitable because of tunneling). Therefore, alternative dielectrics will have to be implemented. Quite interestingly, Miki, Ohji, and Tachi at Hitachi have shown that 50 nm PZT films resulted in the same capacitance as 0.4 nm SiO₂ thin films. However, the question still remains: Will ferroelectrics be the alternative dielectric?

William L. Warren and Bruce A. Tuttle
Sandia National Laboratories
Albuquerque, NM 87185

ISAF 92 POSTER SESSIONS, *cont.*

Dielectric Properties of Bismuth Layer Type Ceramics with Lanthanum and Nickel Cosubstitutions

B. Huang, X. Wang, and X. Yao

Preparation and Phase Transition of Nanophase Ferroelectric PbTiO₃ Fine Powders

S. Lu, L. Zhang, and X. Yao

Amorphization of Bulk and Thin Film PZLT Materials by 1.5 MeV Krypton Ion Irradiation with *in situ* TEM Observation

L. M. Wang and A. Y. Wu

The Temperature Dependence of Sound Velocities, Elastic Constants and Acoustic Attenuation of Lead Lanthanum Zirconate Titanate (Pb,La)(Zr,Ti)O₃

A. Y. Wu, G. Nicolaidis, and D. M. Hwang

Dielectric, Piezoelectric, and Pyroelectric Properties in the Relaxor Ferroelectric (1-x-y) Pb(Mg_{1/3}Nb_{2/3})O₃-xPbTiO₃-yPbZrO₃ System

J. S. Ko, Y. J. Kim, Y. H. Shin, and S. W. Choi

Influence of High Energy Grinding on the Texture, Structure, and Electrical Properties of Barium Titanate

J. M. Criado, F. J. Gotor, L. Perez-Maqueda, C. Real, M. Mundi, and J. del Cerro

90° - Domain Reversal in Pb(Zr_xTi_{1-x})O₃ Ceramics

S. Li, C.-Y. Huang, A. S. Bhalla, and L. E. Cross

Phenomenological Treatment of Dielectric Loss of Ferroelectrics Under Hydrostatic Pressure

S. Fujimoto, Y. Kato, and K. Kanai

-- continued on page 4

ISAF 92 POSTER SESSIONS,*cont.***2. THIN FILMS**

Electrode Effects on Electrical Properties of Ferroelectric Thin Films

D. P. Vijay, C. K. Kwok, W. Pan, I. K. Yoo, and S. B. Desu

Preparation and Characterization of Lead Lanthanum Titanate Thin Films by Metalorganic Decomposition

A. R. Khan, I. K. You, and S. B. Desu

The Use of Design and Experiments to Evaluate the Reliability of Ferroelectric Nonvolatile Memories

T. D. Hadnagy, S. N. Mitra, D. J. Sheldon

Pure and Modified Lead Titanate Thin Films by Sol Gel

D. M. Tahan and A. Safari

Effect of Zr/Ti Stoichiometry Ratio on the Ferroelectric Properties of Sol-Gel Derived PZT Films

G. Teowee, J. M. Boulton, E. A. Kneer, M. N. Orr, D. P. Birnie III, D. R. Uhlmann, S. C. Lee, K. F. Galloway, and R. D. Schrimpf

Compositional Control of Ferroelectric Pb(Zr,Ti)O₃ Thin Films Prepared by Reactive Sputtering and MOCVD

M. Shimizu, K. Hayashi, T. Katayama, and T. Shiosaki

Crystallization and Dielectrical Properties of PLZT Films Derived From Metalloorganic Precursors

P. Sun, L.-Y. Zhang, and X. Yao

Structural Investigation of Thin Film PLZT Using X-Ray Absorption Spectroscopy

R. B. Greeger, F. W. Lytle, and A. Y. Wu

Electrical Characterization of Multi-Ion-Beam Reactive Sputter Deposited PZT Films

H. Hu and S. B. Krupanidhi

-- continued on page 5

ISAF 92 PROCEEDINGS

The following papers were delivered at the 1992 IEEE 8th International Symposium on Applications of Ferroelectrics in Greenville, SC, from 30 August to 2 September 1992.

Pyroelectric Imaging

Pyroelectric Imaging

B.M. Kulwicki, A. Amin, H.R. Beratan, and C.M. Hanson

Pyroelectrics, Electrooptics

Pyroelectric and Electrooptic Properties of Sol-Gel and Dual Ion Beam Sputtered PLZT Thin Films

D.A. Tossell, J. S. Obhi, N. M. Shorrocks, A. Patel, and R. W. Whatmore

Deposition and Properties of PLT Thin Films by Magnetron Sputtering From Powder Target

W.-G. Luo, A.-L. Ding, R.-T. Zhang, Y.-H. Huang, and M. Ge

A Study of the Properties of Acetate-Derived PLZT Films on Glass Substrates

K. D. Preston and G. H. Haertling

Ferroelectric Copolymer and IR Sensor Technology Applied to Obstacles Detection

F. Bauer, J. J. Simonne, and L. Audaire

The Analytic Representation of the Effective Nonlinear Coefficients for Biaxial Crystals in the Coordinate Planes

S. W. Xie, W. Y. Jia, P. J. Wang, and Y. L. Chen

The Concept, Effects and Possible Applications of Optical and Acoustical Superlattices

N.-B. Ming

Lead Calcium Titanate Ceramics and Integrated Optical Filters for Infrared Optical Sensors

J. de Frutos, F. López, and B. Jiménez

The Relation Between the Mg Concentration Threshold Effect and the Defect Structures of the Congruent Mg:LiNbO₃

Q.-R. Zhang and X.-Q. Feng

Optical Associative Memory Using Photorefractive LiNbO₃:Fe Hologram, and LiNbO₃ Fe and BaTiO₃ Phase Conjugate Mirror

Z. Chen, T. Kasamatsu, M. Shimizu, and T. Shiosaki

Dielectrics: Synthesis, Size Effects

The Effect of Dysprosium on the Microstructure and Dielectric Properties of (Ba_{1-x}Sr_x)TiO₃ Ceramics

H.-W. Wang and D. A. Hall

Grain Size Effect on the Dielectric Properties of Strontium Barium Titanate

U. Kumar, S. F. Wang, S. Varanasi, and J. P. Dougherty

Hydrothermal Synthesis of Modified Lead Titanate Powders

C. E. Millar and W. W. Wolny

-- continued on page 5

ISAF 92 PROCEEDINGS

ISAF 92 PROCEEDINGS-- continued from page 4

Sol-Gel Process for the Preparation of Ultrafine BaTiO₃ Powders

Q. Zhang, W. Xue, H. Wang, M. Zhao, and D. Shen

Relaxor Dielectrics: Synthesis and Properties

Dielectric Properties and Crystal Structures of Entire Compositions in the Ternary System Pb(Mg_{1/2}W_{1/2})O₃-Pb(Ni_{1/3}Nb_{2/3})O₃-PbTiO₃

A. Ochi, T. Mori, and M. Furuya

Preparation of Dense Ultra-fine Grain Barium Titanate-Based Ceramic

U. Kumar, S. F. Wang, and J. D. Dougherty

High K Low Firing Temperature Capacitors Based on Lead Niobate

J. E. Day, A. E. Brown, and J. D. Nance

Diffuse Phase Transition and Relaxor Behavior in Perovskites

H. Schmitt, D. Simon, and P. Pitzius

Ferroelectrics: Processing, Properties

Processing of Ferroelectric and Related Materials: A Review

T. R. Shrout and S. L. Swartz

Preparation and Characterization of Barium Titanate Electrolytic Capacitors by Anodic Oxidation of Porous Titanium Bodies

S. Venigalla, P. Bendale, R. E. Chodelka, J. H. Adair, and S. A. Costantino

Synthesis of Ferroelectric Pb_{1-x}Ca_xTiO₃ Single Crystals

N. Ichinose and T. Komachi

Effect of Grain Size on the Grain Boundary Resistance of Undoped Barium Titanate Ceramic

H. Y. Lee and L. C. Burton

Grain Boundary Behaviors of Ferroelectric Ceramics

K. Okazaki, H. Maiwa, M. Hagiwara, and S. Sugihara

Electric Fatigue Initiated by Surface Contamination in High Polarization Ceramics

Q. Jiang, W. Cao, and L. E. Cross

Ferroelectrics: Properties, New Materials

Polarization Fatigue in Perovskite Ferroelectric Ceramics and Thin Films

J. Chen, M. P. Harmer, and D. M. Smyth

Polarization Switching and Long-Time Relaxation Effects Induced by Off-Center Ions in KTa_{1-x}Nb_xO₃

L. A. Knauss, C. Jaquays, P. Adhikari, B. E. Vugmeister, and J. T. Toulouse

Spontaneous Polarization in the Deuterated and Undeuterated Proton Glass Rb_{1-x}(NH₄)_xH₂AsO₄

N. J. Pinto and V. H. Schmidt

Investigation of Ferroelectric and Pyroelectric Properties of Ceramics with Composition Ba(Li_{2x}Al_{2-2x})O_{4-4x}F_{4x} (0 ≤ x ≤ 0.3)

S.-Y. Huang, R. Von Der Mühl, J. Ravez, and P. Hagenmuller

-- continued on page 6

ISAF 92 POSTER SESSIONS

cont.

Sol-Gel Lead Zirconate-Titanate Thin Films: Effect of Solution Concentration

C. Livage, A. Safari, and L. C. Klein

Electrical Characterization of Sol-Gel Derived PZT Thin Films

K. R. Bellur, H. N. Al-Shareef, K. D. Gifford, S. H. Rou, O. Auciello, and A. I. Kingon

Control of Lead Content in PLZT Thin Films Produced Using Cluster Magnetron Sputtering

K. F. Dexter, K. L. Lewis, and J. E. Chadney

3. DIELECTRIC

Effect of Core Shell Morphology on Dielectric Properties of Zr Doped BaTiO₃

T. R. Armstrong R. D. Roseman, and R. C. Buchanan

High Frequency Dielectric Relaxation in Pb(Mg_{0.317}Nb_{0.633}Ti_{0.05})O₃ Ceramics

C. Elissalde, P. Gaucher, and J. Ravez

Dielectric and Ferroelectric Behaviors of Ba(Ti_{1-x}Li_x)(O_{3-3x}F_{3x}) Ceramics

C. Elissalde, J. Ravez, and X. Yao

Relaxation in (Ba_{1-y}Pb_y)TiO₃ Ceramics

S. Kazaoui, C. Elissalde, and J. Ravez

A Low-Firing High Properties MLC

Z. Y. Mao, L. T. Li, and X. Yao

One-Step Low-Temperature Sintering of SrTiO₃ Based Grain Boundary Barrier Layer Capacitor Materials

Z. W. Yin, B. Xu, and H. Wang

Influence of Sintering Condition on Microstructure Development of BaTiO₃ Based PTCR Materials

Z. Z. Huang, H. M. Lu, and Z. W. Yin

-- continued on page 6

ISAF 92 POSTER SESSIONS,
cont.

Quasi Lumped Parameter Method for Microwave Measurements of Dielectric Dispersion in Ferroelectric Ceramics
S. Li, J. Sheen, Q. M. Zhang, A. S. Bhalla, and L. E. Cross

Automated System for Processing of PLZT Powders Derived from Acetate Precursors
J. Barrett and E. C. Skaar

PLZT Powders from Acetate Precursors Via Coprecipitation
C. Lin, B. I. Lee, and G. H. Haertling

Grain Size Effects in Barium Titanate
K. wa Gachigi, U. Kumar, and J. Dougherty

4. PIEZOELECTRIC, ELECTROSTRICTIVE

The Flexible Composite Ferroelectric Functional Films
D. Yang

Hysteresis Behavior and Piezoelectric Properties of Nb Doped PLZT Ceramics
K. V. R. Murty, K. Umakantham, S. N. Murty, K. C. Mouli, and A. Bhanumathi

Electrical Degradation Process and Mechanical Performance of Piezoelectric Ceramics for Different Poling Conditions
T. Tanimoto and K. Okazaki

0-3 Piezoceramic-Polymer Composites Prepared Using Thermoplastics and Elastomers
M. A. Williams, D. A. Hall, and A. K. Wood

Field Dependence of the Electromechanical Properties of Fine Grained Hydrothermally Processed Lead Titanate Ceramics
L. Pardo, J. Ricote, C. Alemany, B. Jimenez, and C. E. Millar

-- continued on page 7

ISAF 92 PROCEEDINGS**ISAF 92 PROCEEDINGS --** *continued from page 5***Microsensors and Microactuators**

Ferroelectric Microsensors and Microactuators
D. L. Polla

Piezoelectrics and Electrostrictives

Modified Lead Containing Perovskite Ceramics for Electrooptic, Electrocaloric, Pyroelectric and Electrostrictive Applications
A. Sternberg, L. Shebanov, E. Birks, M. Ozolinsh, V. Dimza, and E. Klotins

Relaxor Ferroelectrics with Lanthanum Perovskites
T. Takenaka and T. Kanegae

Domain Orientation and Piezoelectric Properties of Ag Doped PMN-PZT Ceramics

K. V. R. Murty, S. N. Murty, K. C. Mouli, and A. Bhanumathi
Grain Size Effect on the Induced Piezoelectric Properties of 0.90PMN-0.10PT Ceramic
S. F. Wang, U. Kumar, W. Huebner, P. Marsh, H. Kankul, and C. G. Oakley

Effective Electromechanical Properties of some $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3\text{-PbTiO}_3\text{-(Ba,Sr)TiO}_3$ Ceramics
S. M. Pilgrim, A. E. Bailey, M. Massuda, J. D. Prodey, and A. E. Sutherland

Piezoelectrics and Electrostrictives

The Effect of Photo-Refractively Induced Periodic Strain Grating on Piezoelectric Vibration in $\text{LiNbO}_3\text{:Fe}$
M. Ohki, N. Taniguchi, and T. Shiosaki

Fabrication of Piezoelectric Ceramic/Polymer Composites by Injection Molding
L. J. Bowen and K. W. French

Piezoelectric Bimorphs with Quadratic Behavior Using Biased ZnO on Si_3N_4
J. G. Smits and W.-S. Choi

Domain Wall Motion in Piezoelectric Materials Under High Stress
S. Sherrit, D. B. Van Nice, J. T. Graham, B. K. Mukherjee and H. D. Wiederick

Domain Investigations: A Select Review
J. Fousek

Dielectrics: Properties, Materials, and Applications

Nonlinear Dielectric Properties of $\text{KTa}_{1-x}\text{Nb}_x\text{O}_3$
X. M. Wang, B. E. Vugmeister, and J. Toulouse

Dielectric Behavior of Ferroelectric Thin Films at High Frequencies
J. Chen, K. R. Udayakumar, K. G. Brooks, and L. E. Cross

continued on page 7

ISAF 92 PROCEEDINGS

ISAF 92 PROCEEDINGS -- *continued from page 6*

PTC Behavior in Ytria Doped BaTiO₃ as Related to Grain Boundary Structure

R. D. Roseman, J. Kim, and R. C. Buchanan

Nondestructive Evaluation of Multilayer Capacitors Using Electromechanical Resonance Phenomena

H. T. Sun, H.-F. Wang, L.-Y. Zhang, and X. Yao

Destruction Mechanism of Multilayer Ceramic Actuators

K. Uchino and A. Furuta

Miscellaneous Materials and Applications

Ferroelectric Phase Shifters for Phased Array Radar Applications

D. C. Collier

Modified Lead Scandium Tantalate for Uncooled LWIR Detection and Thermal Imaging

R. W. Whatmore, N. M. Shorrocks, P. C. Osbond, S. B. Stringfellow, C. F. Carter, and R. Watton

Low Fire Z5U Ceramic Dielectric for Surface Mount MLC

S. P. Gupta, C. R. Koripella, and L. A. Mann

Relaxor Studies of Na, Fe, Mg, Doped SBN Ceramics

S. N. Murty, K. V. R. Murty, G. Padmavathi, K. L. Murty, and A. Bhanumathi

Dielectric and Ferroelectric Properties in the Pb(Mg_{1/3}Nb_{2/3})O₃-PbTiO₃-BaTiO₃ System

S. H. Lee, Y. J. Kim, Y. H. Shin, and S. W. Choi

Thin Films: Electrical Properties

Ultrafast Polarization Switching of Lead Zirconate Titanate Thin Films

P. K. Larsen, G. L. M. Kampschöer, M. B. van der Mark, and M. Klee

Leakage Current Mechanism and Accelerated Unified Test of Lead Zirconate Titanate Thin Film Capacitors

I. K. Yoo and S. B. Desu

AC Conductivity and Dielectric Properties of Sol-Gel PZT Thin Films for Ferroelectric Memory Applications

X. Chen, A. I. Kingon, and O. Auciello

Measurement of Electrooptic Coefficient of Ferroelectric PLZT Thin Films

W.-G. Luo, A.-L. Ding, R.-T. Zhang, K. S. Chan, and G. G. Siu

Transverse Electrooptic Properties of Antiferroelectric Lead Containing Thin Films

F. Wang, K. K. Li, and G. H. Haertling

Fatigue Effect on the I-V Characteristics of Sol-Gel Derived PZT Thin Films

S. C. Lee, G. Teowee, R. D. Schrimpf, D. P. Birnie, III, D. R. Uhlmann, and K. F. Galloway

Defect Structures and Fatigue in Ferroelectric PZT Thin Films

Z. Wu and M. Sayer

ISAF 92 POSTER SESSIONS,
cont.

Processing and Characterization of Ca, Ce and Na Ion Doped Lead Titanates

A. Ahmad, T. A. Wheat, J. D. Canaday, A. K. Kuriakose, S. E. Prasad, and S. Varma

Microstructural, Dielectric, Piezoelectric, and Pyroelectric Properties of Chemically Derived Modified Lead Titanate

A. Ahmad and T. A. Wheat, S. Sherit, and B. K. Mukherjee

Fabrication and Piezoelectric Properties of PZT Ceramics Prepared by Partial Oxalate Method

H.-D. Nam and H. Y. Lee

Microstructure and Properties of Cr₂O₃ Doped Lead Titanate Piezoceramics

L. Wu, Y.-Y. Lee, and C.-K. Liang

Elaboration Process and Study of Nb-Ni Substituted PZT Ceramics with High d₃₃ and r_r Coefficients

L. Eyraud, P. Eyraud, S. Rey, and M. Troccaz

Piezoelectric Actuators in Rotary or Linear Motions by Excitation of Asymmetric Displacement

Y. Tomikawa, M. Aoyagi, and C. Kuskbabe

High Torque Ultrasonic Motor Using Longitudinal and Torsional Vibrations - Characteristics of the Motor with a Revolving Torsional Vibrator Used in Common as a Stator and a Rotor

M. Aoyagi, A. Satoh, and Y. Tomikawa

A Study on the Relationship of Phase Equilibrium and Electromechanical Properties in the Modified PbTiO₃-BiFeO₃ System

P. Lu, W. Zhang, D. Shen, W. Xue, and M. Zha

ISAF 92 POSTER SESSIONS,
cont.

Large Anisotropy on Electromechanical Properties of Rare-Earth and Alkaline-Earth Oxides Complex Modified-PbTiO₃ Ceramics

H. Wang, W. R. Xue, P. W. Lu, D. W. Shen, Q. T. Zhang, and M. Y. Zhao

Sol-Gel Techniques for the Preparation of Ultrafine PbTiO₃ Powders

Q. Zhang, Z. Zhang, D. Shen, H. Wang, W. Xue, and M. Zhao

Development of Portable DC Voltage Standard Using PZTs

M. Lal

The Electrical Properties of Antiferroelectric Lead Zirconate-Ferroelectric Lead Zinc Niobate Ceramics with Lanthanum

J. S. Yoon, V. S. Srikanth, and A. S. Bhalla

The DC Field Dependence of the Complex Piezoelectric, Elastic and Dielectric Constants for a Lead Zirconate-Based Ceramic

E. F. Alberta, D. J. Taylor, A. S. Bhalla, and T. Takenaka

Interfaces Between Electrode Metals and (Pb,La)(Zr,Ti)O₃ in Oxidizing Atmosphere

S. Sugihara and K. Okazaki

The Electrostrictive and Related Properties of (Pb_{1-x}Ba_x)_{1-3z/2}Bi_z(Zr_{1-y}Ti_y)O₃ Ceramic System

G. Li and G. Haertling

Ceramic Actuator with Three-Dimensional Electrode Structure

Y. Fuda, T. Yoshida, T. Ohno, and S. Yoshikawa

Composite of BaTiO₃ and Pb(Zr,Ti)O₃ Fabricated with CO₂ Laser

S. Sugihara

ISAF 92 PROCEEDINGS

ISAF 92 PROCEEDINGS-- *continued from page 5*

Piezoelectrics and Electrostrictives: Composites

New Ferroelectric and Piezoelectric Polymers

J. I. Scheinbeim, B. A. Newman, B. Z. Mei, and J. W. Lee

Strain Profile and Piezoelectric Performance of Piezocomposites with 2-2 and 1-3 Connectivities

Q. M. Zhang, W. Cao, H. Wang, and L. E. Cross

An Optimization of 1.3.1 PZT-Polymer Composite for Deep Underwater Hydrophone Application

C. Richard, P. Eyraud, L. Eyraud, D. Audigier, and M. Richard

Piezoelectric Transducers for Medical Ultrasonic Imaging

T. R. Gururaja

Piezoelectrics and Electrostrictives: Polymers, Transducers, Processing

Piezoelectric Properties of "d₃₃-zero" or "d_h-zero" 1-3 or 2-2 Type Composite Consisting of 0-3 Subcomposite of Polymer/PbTiO₃ and that of Polymer/PZT

H. Banno and K. Ogura

Piezoelectric PZT Tubes and Fibers for Passive Vibrational Damping

S. Yoshikawa, K. G. Brooks, U. Selvaraj, and U. S. K. Kurtz

Piezoelectric Response of Precisely Poled PVDF to Shock Compression Greater than 10 GPa

F. Bauer, R. A. Graham, M. U. Anderson, H. LeFebvre, M. L. Lee, and R. P. Reed

New Extremely Broadband Ferroelectric Polymer Ultrasound Transducers

L. F. Brown

PZT-Based Stacked Acoustic Filters

J. Kosinski, E. Baidy, J. Shannon, A. Safari, and A. Ballato

Thin Films: Processing

Reactive Coevaporation Synthesis and Characterization of SrTiO₃-BaTiO₃ Thin Films

H. Yamaguchi, S. Matsubara, K. Takemura, and Y. Miyasaka

Sol-Gel Processing of Thick PZT Films

G. Yi and M. Sayer

Lead Titanate Thin Films Deposited by Metallorganic Chemical Vapor Deposition (MOCVD)

W. C. Hendricks, C. H. Peng, and S. B. Desu

Bulk vs Thin Film PLZT Ferroelectrics

D. E. Dausch and G. H. Haertling

Highly Oriented (Pb,La)(Zr,Ti)O₃ Thin Films on Amorphous Substrates

A. Y. Wu, D. M. Hwang, and L. M. Wang

Barium Strontium Titanate Thin Films by Multi-Ion Beam Reactive Sputtering Technique

C.-J. Peng, H. Hu, and S. B. Krupanidhi

-- continued on page 9

-- continued on page 9

ISAF 92 PROCEEDINGS

ISAF 92 PROCEEDINGS -- continued from page 8

Controlled Ion Bombardment Induced Modification of PZT Thin Films

H. Hu, and S. B. Krupanidhi

Microwave Assisted Low Temperature Solid Phase Crystallization of Ferroelectric Thin Films

J. Chen, K. R. Udayakumar, and L. E. Cross

Preparation of Lead-Zirconate-Titanate Thin Films by Reactive RF-Magnetron Cosputtering Using Multi-Element Metallic Targets and Their Evaluations

T. Yamamoto, T. Imai, and T. Shiozaki

A Critical Review of Physical Vapor Deposition Techniques for the Synthesis of Ferroelectric Thin Films

O. Auciello and A. Kingon

Thin Films: Applications and CVD

LiNbO₃ Thin Film Capacitor and Transistor Processed by A Novel Method of Photo-Induced Metalloorganic Decomposition

C. H.-J. Huang, H. Lin, and T. A. Rabson

Photo-CVD of Ferroelectric Pb(Zr,Ti)O₃ Thin Films

T. Katayama, M. Sugiyama, M. Shimizu, and T. Shiozaki

MOCVD Growth of BaTiO₃ in an 8" Single-Wafer CVD Reactor

P. C. Van Buskirk, P. S. Kirlin, R. Gardiner, and S. B. Krupanidhi

Chemically Prepared Pb(Zr,Ti)O₃ Thin Films: The Effects of Orientation and Stress

B. A. Tuttle, J. A. Voigt, T. J. Garino, D. C. Goodnow, R. W. Schwartz, D. L. Lamppa, T. J. Headley, and M. O. Eatough

Thin Films: Applications and Processing

DAAS Technique for Synthesizing Doped PZT and PLZT Thin Films

C. T. Lin, L. Li, J. S. Webb, R. A. Lipeles, and M. S. Leung

The Study of PZT Ferroelectric Thin Film and Composite with Amorphous Silicon

Y. L. Wang, D. H. Wu, H. T. Chen, and D. W. Yu

Microstructure-Induced Schottky Barrier Effects in Barium Strontium Titanate (BST) Thin Films for 16 and 64 Mbit DRAM Cells

J. F. Scott, M. Azuma, E. Fujii, T. Otsuki, G. Kano, M. C. Scott, C. A. Paz de Araujo, L. D. McMillan, and T. Roberts

To order copies of the 1992 IEEE International Symposium on Applications of Ferroelectrics, contact

IEEE Service Center

445 Hoes Lane

Piscataway, NJ 08854-IEEE

IEEE Catalog Number: 90CH3080-9

In case you need further assistance, call Pat Thompson at Conference Services (908) 562-3872.

ISAF 92 POSTER SESSIONS, cont.

Anomalous Mechanical and Piezoelectric Coefficients in Piezoceramics Used for Ignition

P. Gonnard, C. Garabédian, H. Ohanessian, and L. Eyraud

The Mechanism of Low Temperature Sintering PZT Ceramics with Additives of Li₂O-Bi₂O₃-CdO

X. Wang, P. Lu, D. Shen, W. Xue, and M. Zhao

Dielectric, Piezoelectric, and Pyroelectric Properties in the Pb(Mg_{1/3}Nb_{2/3})O₃-PbTiO₃-Pb(Zn_{1/3}Nb_{2/3})O₃ System

S. H. Lee, Y. J. Kim, K. C. Kim, and S. W. Choi

5. ELECTROOPTIC, PYROELECTRIC, PHOTOREFRACTIVE

Influence of Moisture on Pyroelectric Properties of Bone

V. E. Khutorsky and S. B. Lang

A PLZT Optical Phase Modulator and its Applications

F. Wang, and G. H. Haertling

Model of Electrooptic Effects by Green Function and Summary Representation: Applications to Bulk and Thin Film PLZT Displays and Spatial Light Modulators

A. Y. Wu, T. C. C. Chen, and H. Y. Chen

Field Enhancement and Reduction and Elimination of Remanent Light Flow in Electrooptic Bulk and Thin Film Displays and Spatial Light Modulators: Theory and Practice

A. Y. Wu

The Self-Second Harmonic Generation Crystal NYAB Pumped by the Laser Output of Ti³⁺:Al₂O₃

S. W. Xie, W. Y. Jia, P. J. Wang, T. Liou, and Y. L. Chen

-- continued on page 10

ISAF 92 POSTER SESSIONS,
cont.

Raman Spectroscopy and Nonlinear Optical Properties of PbTiO₃ Suspension

Y. Han, Q. Zhou, L. Zhang, and X. Yao

Automatic Ellipsometry Measurement for Anisotropic Materials

Y. Li, B. You, L. Zhang, and X. Yao

Optical Properties of LiNbO₃, with Ion Implantation and Titanium Thermal Diffusion

B. You, L. Zhang, and X. Yao

Optical Properties of PbTiO₃/Epoxy O₃ Fine Composites

Q. F. Zhou, Y. Han, L. Y. Zhang, and X. Yao

Measurement of Dark Conductivity at Extremely Low Light Levels Using Photorefractive Two Wave Mixing

A. E. Clement, G. C. Gilbreath, R. McKnight, Jr., J. Reintjes, and J. M. K. Chock

Photorefractive Image Amplification at Extremely Low Light Levels

G. C. Gilbreath, A. E. Clement, J. Reintjes, and R. A. McKnight, Jr.

Conference organizers

Do you want current or back issues of the **Ferroelectricity Newsletter** to distribute at your event?

Contact
Hannah Liebmann
the earlier the better
at
Tel (408) 649-5899
Fax (408) 655-3734
for free copies.

SCIENTIFIC JOURNALS

THE GORDON AND BREACH FAMILY OF JOURNALS ON FERROELECTRICS

Gordon and Breach Science Publishers offers three journals in the field of ferroelectrics:

FERROELECTRICS

The international journal devoted to the theoretical, experimental, and applied aspects of ferroelectrics and related materials

Editor: **George W. Taylor**, Princeton Resources, PO Box 211, Princeton, NJ 08540 USA

Associate Editors: **Peter Günter**, Institut für Quantenelektronik, ETH Zürich, Switzerland; **Sidney B. Lang**, Department of Chemical Engineering, Ben Gurion University of the Negev, Beer Sheva, Israel; **Koichi Toyoda**, Research Institute of Electronics, Shizuoka University, Hamamatsu, Japan.

Ferroelectrics is designed to provide a forum for people working in ferroelectrics and related materials such as ferroelastics, ferroelectric-ferromagnetics, piezoelectrics, pyroelectrics, nonlinear dielectrics, and liquid crystals. *Ferroelectrics* publishes experimental and theoretical papers aimed at the understanding of ferroelectricity and associated phenomena and applied papers dealing with the utilization of these materials in devices and systems. An important aspect of *Ferroelectrics* is to provide a vehicle for the publication of interdisciplinary papers involving ferroelectricity.

The editor invites original papers and short communications on the theory, fabrication, properties, and application of ferroelectrics and related materials. In addition to research papers, *Ferroelectrics* publishes appropriate and timely review articles. There are no charges to authors or institutions.

FERROELECTRICS LETTERS

Editor: **George W. Taylor**, Princeton Resources, PO Box 211, Princeton, NJ 08540 USA

Associate Editors: **Amar S. Bhalla**, Materials Research Laboratory, Pennsylvania State University, University Park, PA; **Peter Günter**, Institut für Quantenelektronik, ETH Zürich, Switzerland; **Sidney B. Lang**, Department of Chemical Engineering, Ben Gurion University of the Negev, Beer Sheva, Israel; **Lev A. Shuvalov**, Institute of Crystallography, Academy of Sciences of Russia, Moscow, Russia; **Koichi Toyoda**, Research Institute of Electronics, Shizuoka University, Hamamatsu, Japan.

Ferroelectrics Letters, a separately published section of *Ferroelectrics*, permits the rapid publication of important, quality, short original papers on the theory, synthesis, properties, and application of ferroelectrics and related materials.

INTEGRATED FERROELECTRICS

Editor-in-Chief: **George W. Taylor**, Princeton Resources, PO Box 211, Princeton, NJ 08540 USA.

Chief Associate Editor: **Carlos A. Paz de Araujo**, Department of Electrical and Computer Engineering, University of Colorado, Colorado Springs, CO.

UPCOMING MEETING

Nonvolatile Memory Technology Review
22 - 24 June 1993
Baltimore, MD

The Nonvolatile Memory Technology Review is the premier international forum for presentation of NVM technology options. The conference mission is to promote communication between NVM technologists and NVM users. Its scope includes both very small and very large storage systems and all classes of implementation technologies. The technical program encompasses present and future NVM systems requirements as well as current and emerging NVM approaches. Technologies include, but are not limited to, semiconductor, magnetic, and optical NVMs. Both technology and application are emphasized and overview analysis and comparison studies are discussed.

Scope

- | | | |
|--|---|--|
| <ul style="list-style-type: none"> • Current NVM research topics • Error control approaches • Mass storage systems • Bloch line technology • Crash recorder technology • Flash memory • Emerging memory card technology | <ul style="list-style-type: none"> • Packaging technology • New memory media • Magnetic discs/drums/tapes • Avionics & missile storage • Ferroelectric memory • PC storage systems | <ul style="list-style-type: none"> • Emerging storage requirement • Optical disc/tape • Space storage systems • Magnetoresistive memory • Main frame storage systems • EEPROM devices • SONOS devices • Miniature disc |
| <ul style="list-style-type: none"> technology • CMOS/battery devices | <ul style="list-style-type: none"> • memory power management | <ul style="list-style-type: none"> • Analog storage devices |

Sponsors

AFCEA Central Maryland Chapter
 Signal Corps Regimental Association
 IEEE Components, Hybrids, and Manufacturing Technology Society

Contact

General chair: Ron Kushnier, NAWCADWAR (215) 441-1624
 Program chair: Joe E. Brewer, Westinghouse (410) 765-1247
 Administrative chair: MAJ Jane H. Smith, US Army Signal Corps (410) 684-7217


SCIENTIFIC JOURNALS -- continued from page 10

Associate Editors: **James F. Scott**, Department of Physics, University of Colorado, Boulder, CO; **Alexander S. Sigov**, Moscow Institute of Radioengineering, Electronics, and Automation, Moscow, Russia; **Tadashi Shiosaki**, Department of Electronics, Faculty of Engineering, Kyoto University, Kyoto, Japan; **Wolfram Wersing**, Corporate Research and Development, Siemens AG, Munich, Germany.

Bibliographer: **Koichi Toyoda**, Research Institute of Electronics, Shizuoka University, Hamamatsu, Japan

Book Review Editor: **Rainer Zuleeg**, San Juan Capistrano, CA

INTEGRATED FERROELECTRICS provides an international, interdisciplinary forum for electronic engineers and physicists as well as process and systems engineers, ceramicists, and chemists who are involved in research, design, development, manufacturing, and utilization of integrated ferroelectric devices. Such devices unite ferroelectric films and semiconductor integrated circuit chips. The result is a new family of electronic devices which combine the unique nonvolatile memory, pyroelectric, piezoelectric, photorefractive, radiation-hard, acoustic and/or dielectric properties of ferroelectric materials with the dynamic memory, logic and/or amplification properties, miniaturization, and low-cost advantages of semiconductor IC technology.



CALENDAR OF EVENTS

<p>April 5 - 7</p> <p>12 - 16</p> <p>18 - 22</p> <p>19 - 21</p>	<ul style="list-style-type: none"> • The Dielectrics Society 1993 Annual Conference, Canterbury, UK (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 7) • The 1993 Spring Meeting of the Materials Research Society, San Francisco, CA (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 7). • Annual Meeting of the American Ceramics Society, Cincinnati, OH • 5th International Symposium on Integrated Ferroelectrics, Colorado Springs, CO (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 9).
<p>June 22 - 24</p>	<ul style="list-style-type: none"> • Eighth Biannual Nonvolatile Memory Technology Review, Baltimore, MD (see p. 11).
<p>July 1</p>	<ul style="list-style-type: none"> • MRS 1993 Fall Meeting abstracts due
<p>August 8 - 13</p>	<ul style="list-style-type: none"> • The Eighth International Meeting on Ferroelectricity, Gaithersburg, MD (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 10).
<p>September 13 - 18</p> <p>28 - 1 Oct</p>	<ul style="list-style-type: none"> • 2nd International Conference on Magnetoelectric Interaction Phenomena in Crystals, Monte Verita, Ascona, Switzerland (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 11). • Fourth International Conference on Ferroelectric Liquid Crystals, Tokyo, Japan (see <i>Ferroelectricity Newsletter, Vol.1, No.1</i>, p. 9).
<p>November 7 - 10</p> <p>29 - 3 Dec</p>	<ul style="list-style-type: none"> • The 1993 PAC RIM Meeting of the American Ceramic Society, Honolulu, HI: International Symposium on Ferroelectric Thin Films. Contact Isabel K. Lloyd, University of Maryland, Materials & Nuclear Engineering, College Park, MD 20742-2115; Phone (301) 405-5221, Fax (301) 314-9467. • MRS 1993 Fall Meeting, Boston, MA. Contact Philippe M. Fauchet, Phone (716) 275-1487, Fax (716) 275-2073; David B. Poker, Phone (615) 576-8827, Fax (615) 576-6720; Alan I. Taub, Phone (518) 387-6234, Fax (518) 387-6232.

SPACE SYSTEMS ACADEMIC GROUP
 CODE SP
 NAVAL POSTGRADUATE SCHOOL
 MONTEREY, CA 93943