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Ferroelectricity Newsletter

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

Volume 3, Number 2 Spring 1995

BY OCTOBER, THE FERROELECTRICITY NEWSLETTER WILL BE AVAILABLE ON WORLD WIDE WEB

The time has come for the ***Ferroelectricity Newsletter*** to utilize the communications superhighway. Starting with the Fall 1995 issue, access to the newsletter will be provided through **World Wide Web**.

Distributing the newsletter electronically cuts out the time it takes to get it printed, prepared for shipping, and mailed. You will receive it sooner, and help us save money. Furthermore, utilizing World Wide Web is environmentally sound.

The ***Ferroelectricity Newsletter*** can be accessed electronically via the **Space Systems Academic Group Web Server** at the Naval Postgraduate School. To do this, you will need a computer workstation that has a **Web browser** installed with access to **Internet**. Popular Web browsers are **Mosaic** and **Netscape**. These browsers are available on **PCs, Macintosh-type computers**, and **UNIX workstations**. If you are not familiar with these resources, you should contact a system administrator and ask for access to World Wide Web.

To access the ***Ferroelectricity Newsletter***, you need the address of what is called a **Web home page.** These Web addresses are named **URLs (Uniform Resource Locators)**. The URL of the Ferroelectricity home page at the Space Systems Academic Group is:

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

Using your Web browser, you can enter the URL specified above into the **Location** field, located close to the top of the Mosaic and Netscape browser displays.

What do you have to do now?

The Summer 1995 issue, to be published in August, will still be mailed to everybody. If you want to continue receiving the newsletter in its present form after the Summer issue, please let us know. If we do not hear from you by **15 September 1995**, we will assume that you prefer to receive the newsletter electronically. Choose any of the following ways to reach us:

E-mail **rpanholzer@nps.navy.mil**
Phone **+(408) 649-5899**
Fax **+(408) 655-3734**
Mail **Hannah Liebmann, 500 Glenwood Circle, Suite 238 Monterey, CA 93940-4724, USA**

We hope you will take advantage of this opportunity to further strengthen our communication and information network.

Rudolf Panholzer
Editor-in-Chief

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Ferroelectricity Newsletter
Volume 3, Number 2
Spring 1995

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

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ISIF 95 PAPERS

The **7th International Symposium on Integrated Ferroelectrics** was held in **Colorado Springs**, Colorado, from **20 to 22 March 1995.** The ISIF 95 proceedings will be published in ***Integrated Ferroelectrics.***

Materials Processing - CVD

Ferroelectric Thin Films by Solid Source MOCVD
R. Hiskes et al

Preparation of $SrTiO_3$ Thin Films by Electron Cyclotron Resonance (ECR) Plasma MOCVD
H. Yamaguchi et al

PZT, PLZT, LSC, and Pt Thin Films Produced in the Open Atmosphere Using Combustion Chemical Vapor Deposition, a Novel CVD Technique
A. Hunt et al

Manufacturing of Perovskite Thin Films Using Liquid Delivery MOCVD
P. Van Buskirt et al

Properties of Ferroelectric (Pb, La)(Zr, Ti)O_3 Thin Films by MOCVD
M. Shimizu et al

Organometallic Chemical Vapor Deposition of Lead Zirconate Titanate
M. de Keijser et al

Deposition and Properties of $PbTiO_3$ Thin Films on Various Substrates by Organometallic Chemical Vapor Deposition
Y. S. Yoon et al

$SrRuO_3$ and $CaRuO_3$ Oxide Electrode Materials and $Pb(Zr,Ti)O_3$/$SrRuO_3$ and $Pb(Zr,Ti)O_3$/$CaRuO_3$

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PIEZOELECTRIC ACTUATORS

PIEZOELECTRIC ACTUATORS/ULTRASONIC MOTORS: Their Developments and Markets

Eighteen years have passed since the intensive development of piezoelectric/electrostrictive actuators started, and the focus has been shifted to practical device application. Piezoelectric shutters (Minolta Camera) and automatic focusing mechanisms in cameras (Canon), dot matrix printers (NEC), and part feeders (Sanki) have been commercialized and mass produced at several ten thousands of pieces per month. During this period of commercialization, new designs and drive/control techniques of the ceramic actuators have been mainly developed in these couple of years.

This article discusses recent development trends of piezoelectric actuators and ultrasonic motors viewed from Japanese patent disclosures and predicts their future.

In Japan, piezoelectric actuators and ultrasonic motors have been developed by private industries aiming at applications to precision positioners and compact motors and are too practical to be supported by the Japanese government. The only big national project currently underway in this field is on micromechanisms, which primarily covers the silicon micromachining related micromotors. By contrast, developments in the United States in this area are predominantly supported by government institutions related to the military and are mainly focused on active vibration control.

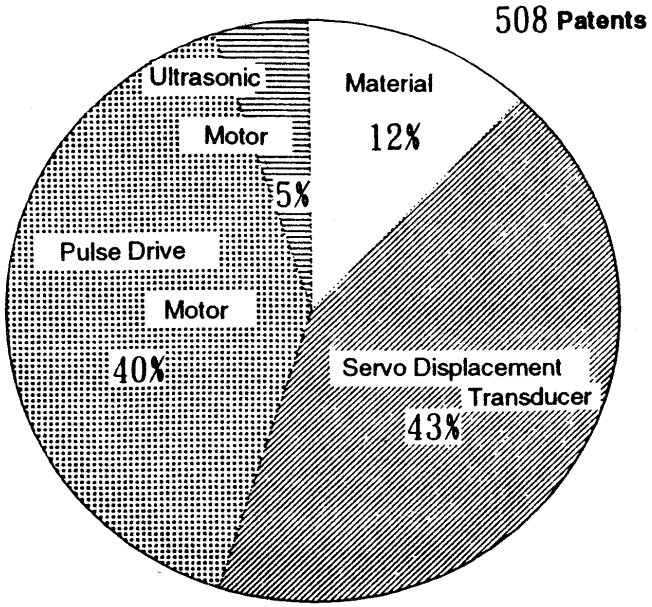

Fig.1 The ratio of 508 piezo-actuator related patents with respect to the technical content disclosed during 1972 -84.

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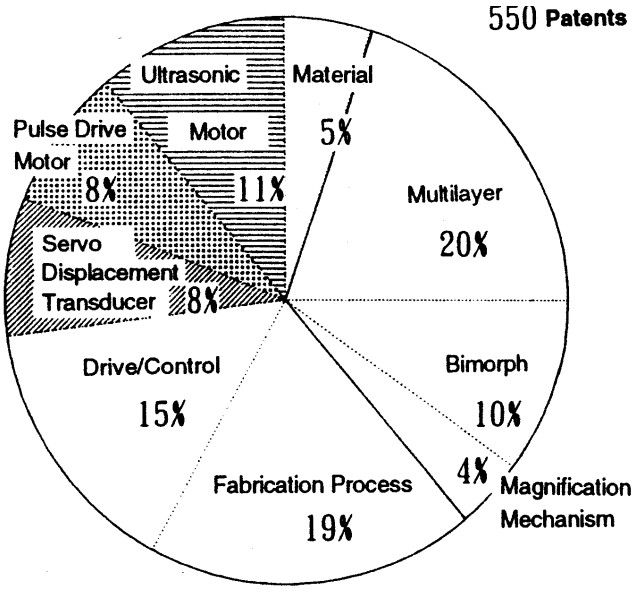

Fig.2 The ratio of 550 piezo-actuator related patents with respect to the technical content disclosed during 1988 - 90.

Development Trend Viewed From Patent Disclosure

Most of the top ten companies (NEC, TOTO Corporation, Matsushita Electric, Brother Industry, Toyota Motors, Tokin, Hitachi Metal, Toshiba, Nippon Denso, and Fuji Electric) have already started to supply products of piezoelectric actuators/ultrasonic motors or their application devices. Only TOTO Corporation and Fuji Electric have not disclosed their targets explicitly.

Fig. 1 shows patent disclosure with respect to technical content for 508 patents from 1972 to 1984, and Fig. 2 for 550 patents from 1988 to 1990. It is interesting to note that device applications account for the largest share of patents in Fig. 1, while they only represent one quarter of patents in Fig. 2. The significance of actuator design in recent years is highlighted by the fact that more than half of the patents are in this field. Regarding application, servo displacement transducers and pulse drive motors account for 40 and 43 percent respectively during the period of 1972 to 1984, while ultrasonic motors took only five percent. By contrast, from 1988 to 1990 servo displacement transducers and pulse motors had only eight percent each, while the ultrasonic motors' share increased to 11 percent.

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Thin Films Prepared by MOCVD and RF Sputtering
C. M. Foster et al

Liquid Source Misted Chemical Deposition - Critical Review
M. Huffman

Lead Zirconate Titanate (PZT) Thin Films Prepared by Electrostatic Spray
M.-D. Liu et al

Characteristics of Off-Axis Magnetron Sputtered PZT Thin Films on LSCO Electrode
T. S. Kim et al

Characterization of (Pb,La)TiO_3 Thin Films by Radio Frequency Magnetron Sputtering and Their Electrical Properties
S. J. Chae et al

Structural and Dielectric Properties of $Ba_{0.5}TiO_3$ Thin Films by Pulsed Laser Deposition
Q. X. Jia et al

Effect of Oxygen Pressure Microstructure, Texture, and Growth Characteristics of Laser Ablated $BaTiO_3$ Thin Films
M.-H. Yeh, K.-S. Liu et al

Laser Ablated PZT Thin Films for Piezoelectric Microsensor and Microactuator Applications
A. S. Nickles et al

Synthesis of Epitaxial-Like $(Sr_{0.5}Ba_{0.5})Nb_2O_6$ Thin Films on Silicon Substrate
W. J. Lin et al

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Effects of Process Variations on Solution Deposited PZT Thin Film Properties and Structural Evolution
R. W. Schwartz et al

Microstructural Development of Sol-Gel Derived Barium Titanate Thin Films
M. L. Mecartney et al

Novel Precursors for Sol-Gel Derived PMN and PMN-PT Powders and Thin Films
T. J. Boyle et al

Modification of PZT Nucleation and Growth Using Oxide Layers in Multilayered Electrodes
I. Chung et al

Sol-Gel Processing of Barium Strontium Titanate Films
M. Sedlar and M. Sayer

Crystallization of Rapid Thermal Processed PZT: Effect of Oriented Ruthenium Oxide Electrodes
E. M. Griswold et al

Water Soluble Solution Derived Ferroelectric Films for Microelectro-Mechanical Devices
P. F. Baude et al

Compositional Tailoring of the Dielectric Properties of Sol-Gel Derived PLZT Thin Films
V. Poplavko et al

An Expanded MOD System for Advanced Oxide Synthesis
M. C. Scott and J. D. Cuchiaro

Electrical Properties of Doped PZT Thin Films Prepared by Sol-Gel Process
W. Lee et al

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PIEZOELECTRIC ACTUATORS

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In its first stage, the development of piezoelectric actuators by electronic manufacturing companies was focused on inexpensive mass-production devices, such as computer related apparata, displays, and sensors. Typical examples are dot matrix printers by NEC, swing CCD image devices by Toshiba, VCR tracking heads by Sony and Matsushita Electric, and piezoelectric relays by Omrom. At the second stage, chemical companies, including organic/petrochemical industries, have recently started to be involved in electroceramic areas (TOTO Corporation, Tokin, Hitachi Metal, Murata Manufacturing Co., Ube Industry, Tosoh, NTK, Mitsubishi Kasei, Sumitomo Special Metal, and Toshiba Ceramics). Using the fine manufacturing technology of raw ceramic powders, they are trying to expand their territory to device application in collaboration with optic or mechanical industries. When used in precision cutting machines, quality and reliability of actuators are essential rather than their price.

The Market of Piezoelectric Actuators and Ultrasonic Motors

Presently NEC and Tokin are each producing multilayer actuators at the rate of roughly one million pieces per year. The average price per piece is $100. Consequently, the total market value reaches $200 million. In five years the production rate is expected to increase ten times, while the cost is expected to decrease by a quarter, leading to a total market growth of up to $500 million.

Piezobimorph type camera shutters have been widely commercialized by Minolta Camera. The production of the "Mac Dual" series reaches about 300,000 pieces per year and with the cost of the average lens at $700, total sales are boosted to $210 million.

The actual market of ultrasonic motors opened in June 1986 when Shinsei Industry started to supply trial- manufactured ultrasonic motors using a propagation wave type. After that Shinsei Industry has developed various applications, including a remarkable success with nuclear magnetic resonance medical instruments. Massproduced samples (1500 pieces) were first employed for automatic curtain drawers in the New Tokyo Municipal Building in 1990, which greatly accelerated commercialization. In 1991, an automobile application--one of the key usages of ultrasonic motors--was realized for headrest control in Toyota New Crown. Canon succeeded in EOS exchange lens applications and is presently developing much smaller inexpensive motors which will be applicable for automatic film winding. Applications of ultrasonic motors in cameras will undoubtedly be successful within three years. Seiko Instrument started to distribute miniaturized 10mm motors, especially suitable for watch applications. Sanki's part-feeders are now sold at a rate of 20,0000 pieces per year at an average price of $500 per piece, resulting in total sales of about $10 million. One of the largest markets of ultrasonic motors in the future will be automatic window shutter

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systems. The price of $2,000 per unit multiplied by 100,000 sets per year provides $200 million in sales. Applications in floppy drives, CD/laser disk drives, and other devices will constitute another big market in the future.

Taking account of estimated annual sales of $500 million for ceramic actuator elements, $300 million for camera related devices, and $150 million for ultrasonic motors, piezoelectric/electrostrictive actuators and ultrasonic motors are expected to increase their market share to more than $1 billion by the year 2000. Regarding all actuator related products, $10 billion in sales will be a realistic number, and we can anticipate a bright future in many application fields.

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NEW PUBLICATIONS BY THE MATERIALS RESEARCH SOCIETY

Polycrystalline Thin Films: Structure, Texture, Properties and Applications

Vol. 343 in the MRS Symposium Proceedings Series, 111 papers (769 pages) from the 1994 MRS Spring Meeting in San Francisco, CA. Edited by Katayun Barmak (Lehigh University), Michael Andrew Parker (IBM Storage Systems Division), Jerrold A. Floro (Sandia National Laboratories), Robert Sinclair (Stanford University, and David A. Smith (Stevens Institute of Technology). Hardcover or microfiche: $50 (MRS members), $57 (US list), $65 (foreign list).

Epitaxial Oxide Thin Films and Heterostructures

Vol. 341 in the MRS Symposium Proceedings Series; 54 papers (407 pages) from the 1994 MRS Spring Meeting in San Francisco, CA. Edited by David K. Fork (Xerox Palo Alto Research Center), Julia M. Phillips (AT&T Bell Laboratories), R. Ramesh (Bellcore), and Ronald M. Wolf (Philips Research Laboratory). Hardcover or microfiche: $42 (MRS members), $48 (US list), $55 (foreign list).

Gas-Phase and Surface Chemistry in Electronic Materials Processing

Vol. 334 in the MRS Symposium Proceedings Series, 81 papers (553 pages) from the 1993 MRS Fall Meeting in Boston, MA. Edited by T. J. Mountziaris (State University of New York), G. R. Paz-Pujalt (Eastman Kodak Company), F. T. J. Smith (LORALInfrared and Imaging Systems), and P.R. Westmoreland (University of Massachusetts). Hardcover or microfiche: $64 (MRS members), $74 (US list), $79 (foreign list).

Mechanism of Thin Film Evolution

Vol. 317 in the MRS Symposium Proceedings Series, 96 papers (631 pages) from the 1993 MRS Fall Meeting in Boston, MA. Edited by Steven M. Yalisove (University of Michigan), Carl V. Thompson (MIT), and David J. Eaglesham (AT&T Bell Laboratories). Hardcover or microfiche: $63 (MRS members), $73 (US list), $78 (foreign list).

For further information or to place an order, contact MRS, Publications Department, 9800 McKnight Road, Pittsburgh, PA 15237, phone (412) 367-3012, fax (412) 367-4373 □

ISIF 95 PAPERS

cont.

Processing and Properties of Lead Titanate-Polymer Composite Coatings
J. S. Wright et al

Structural and Electrical Properties of MOD Processed $Sr(Ti_{1-y}Zr_yO_3$ (y=0.1) Thin Films
S. Hoffmann, R. Waser, and M. Klee

Integration of Sol-Gel Derived PZT With SOS Technology
J. S. Obhi et al

Applications and Devices — Microwave and Diverse

Imagewise Poled Ferroelectric Layers for Printing Applications
A. Hirt

Partial Switching Characteristics of Ferroelectric Films and Their Application to Adaptive Learning Neurodevices
H. Ishiwara et al

The Role of Ferroelectrics for Future Spacecraft
S. Thakoor

Nonvolatile Ferroelectric-Superconducting Field Effect Transistor
A. Ignatiev et al

Thin Film Decoupling Capacitors for Multichip Modules
D. Dimos et al

Investigation of Thin Film Ferroelectric Materials for Application in High Frequency Decoupling Capacitors
W. Williamson , III et al

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Structural and Dielectric Properties of $Ba_{0.5}Sr_{0.5}TiO_3$ Thin Films by Off-Axis Sputtering
S. Y. Hou et al

Frequency Tunable Ferroelectric/Superconducting Structures for Microwave Applications
C. H. Mueller et al

Tunable Microwave Resonators: A Method for Measuring the Dielectric Properties of Thin Film Ferroelectrics
D. Galt and J. C. Price

Thin Films of Novel Ferroelectric Composites
S. Sengupta et al

Thick Film Fabrication of Ferroelectric Phase Shifter Materials
M. E. Molongoski et al

Ferroelectric Film Planar Capacitor With HTSC Electrodes
S. F. Karamenko et al

Applications and Devices — Nonvolatile Memory
Characterization of Ferroelectric Capacitors for Nonvolatile Memory Applications
P. K. Larsen et al

The Commercialization of Ferroelectric Memories
E. Philofsky

Characterization of an N-Channel 1T-1C Nonvolatile Memory Cell Using Ferroelectric $SrBi_2Ta_2O_9$ as the Capacitor Dielectric
B. M. Melnick et al

Properties of Ferroelectric/Semiconductor Nondestructive-Readout Memory Devices
C. H. Seager et al

PZT Capacitors With Low Fatigue and Imprint Losses
J. T. Evans, Jr. et al

Electrical Properties of PZT Thin Films for Memory Application
T. Nakamura et al

Electrode Technology for Novolatile Memories
B. A. Tuttle et al

Ferroelectric Capacitor Nondestructive Readout Memory
O. G. Ramer et al

Principle of Nonvolatile Ferroelectric Memories — Design of Novel Flash Ferroelectric Memories
D.-Y. D. Chen

New Architecture of Nondestructive Readout Raw-Matrix Ferroelectric Memory for Gbit Memory
T. Mihara et al

Retention Effects in Thin Ferroelectric Film Tranistors
J. T. Evans, Jr. et al

Applications and Devices — Optical and Pyroelectric
Ferroelectric Films for CCD Microprocessors
A. S. Sigov

Pyroelectric Infrared Sensors Made of La-Modified $PbTiO_3$ Thin Films and Their Applications
R. Takayama

Light Scattering from Sol-Gel Pb(Zr, Ti)O_3 Films: Surface Versus Volume Scattering
M. B. Sinclair et al

Investigation of Optical Loss Mechanism in Oxide Thin Films
A. F. Chow et al

Evaluation of Electrooptic Phenomena in Ferroelectric Thin Films Using Ellipsometric Techniques
B. G. Potter et al

Pulsed Laser Depostion of Optical Waveguiding $Ba_2NaNb_5O_{15}$ Films on $KTiOPO_4$ Substrates
J.-M. Liu et al

Uncooling GaAs 'Pyroelectric' Sensor
Y. V. Prokopenko et al

Pyroelectric Sensors and Arrays Based on P(VDF/TrFE) Copolymer Films
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Piezoelectric MOSFETs With Ferroelectric Gate Insulators
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Thin Film Lithium Niobate and Sapphire for SAW Applications
K.-S. Ho et al

The Research of $LiNbO_3$ Thin Films Deposited on Si Substrates With SiO_2 Coating and Its SAW Application
J. Lin et al

Testing the Oxygen Sensitive Properties of $SrTiO_3$ Thin Films at High Temperatures
J. Gerblinger

Ferroelectric Based Microactuators
W. P. Robbins et al

Fabrication and Characterization of PZT Thin Films on Membranes for Microactuators
P. Muralt et al

Characterization and Testing

Depolarization Characteristics of Ferroelectric $Pb(Zr_{0.4})Ti_{0.6})O_3$ and $SrBi_2Ta_2O_9$ Thin Films
T. Mihara et al

Polarization-Dependent Transient Currents in PZT Films
A. K. Tagantsev et al

Effect of the Sensing Capacitance in a 'Sawyer-Tower' Setup on Hysteresis Loops: Model Calculations and Experiemntal Comparison Between $Pb(Zr,Ti)O_3$ and Y1-Type $SrBi_2Ta_2O_9$
P. Zurcher et al

Analysis of $Pb(Zr,Ti)O3$ Thin Films Using Micro X-Ray Diffraction Techniques: Real-Time Observation of Domain Switching
M. A. Rodriguez et al

Switching of Ferroelectric Thin Films
J. Chen et al

Domain Kinetics in Polycrystal Thin Film Grain Effects
V. Y. Shur et al

Investigation of Dielectric Hysteresis Effect in Layered Structures Based on Strontium Titanate
A. I. Dedyk et al

Transient Current During Switching in Increasing Electric Field as a Basis for a New Testing Method
V. Y. Shur et al

Dielectric Relaxation of Perovskite-Type Oxide Thin Films
M. Schumacher

Dielectric Properties of Ferroelectric Thin Films in the Frequency Range MilliHz to GHz
V. Chivukula

Low Temperature (77K) Dielectric Properties of Acetate Derived PLZT, PBZT, and PSZT Thin/Thick Films
G. H. Haertling

The High Frequency and High Tempaerature Electromechanical Properties of Ferroelectric Materials Determined by Brillouin Scattering
Z. Li et al

Nonstoichiometry, Defect Chemistry, and Electrical Transport on $Pb(Zr_{1/2}Ti_{1/2}O_3$ Ceramics
M. V. Raymond and D. M. Smyth

Point Defect Characterization of Thin Film Pb(Zr,Ti)O3
A. Krishnan , D. J. Keeble et al

Evaluation of C-V Analysis for Determining the Effective Doping Concentration in Ferroelectric Thin Films
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The Influence of Doping on the Large-Signal CV Behavior of Ferroelectric Thin Film Capacitors
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Relating the Electrically Active Doping Level of PZT Thin Films to CV Measurement
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The Nature of Voltage Shifts in $Pb(Zr,Ti)O_3$
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The Imprint Mechanism in Ferroelectric Capacitors
J. T. Evans, Jr. et al

Imprint of $(Pb,La)(Zr,Ti)O_3$ Thin Film Capacitors With $(La, Sr)CoO_3$ Electrodes
J. Lee et al

The Temperature Dependence of Ferroelectric Imprint
J. M. Benedetto et al

DC-Voltage and Cycling Induced Recovery of Switched Polarization in Fatigued Ferroelectric Thin Films
E. L. Colla et al

Electrode Contacts on Ferroelectric Thin Films and Their Influence on Fatigue Properties
J.J. Lee and S. B. Desu

Effects of Electrode Materials for PZT Thin Film Capacitors
Y. Nakao et al

Optical Studies of PZT/Metal and Metal-Oxide Interfaces
S. Mansour et al

Electrical Characterization of PZT on Rapid Thermally Annealed Ruthenium Oxide Electrodes
D. S. McIntyre et al

Experimental Studies of Interfacial Phenomena in Barium-Strontium Titanate (BST) Devices
J. F. Scott et al

Effect of RuO_X Bottom Electrode Annealing Temperature on Sol-Gel Derived PZT
C. J. Rawn et al

Structural Phase Transitions in Modified Lead Zirconate
R. W. Whatmore

Main Stages of Crystallization in Thin Ferroelectric Testing by Elastic Light Scattering
V. Y. Shur et al

Evolution of Domain Structure in $(Pb, La)TiO_3$ Thin Films on Various Substrates
Y. Kang et al

Nonorthogonal Twinning in Thin Film Oxide Perovskites
K. P. Fahey et al

In Situ, Real-Time Characterization of Growth Processes During Synthesis of Ferroelectric Thin Films and Heterostructures to Control Composition and Properties
O. Auciello et al

Device Processing and Integration

Effect of Ion Beam Etching on Electrical Properties of PZT Thin Film Capacitors
C. Chung et al

Breakdown Mechanisms in PZT Thin Film Capacitors
I. K. Yoo and S. B. Desu

The Effect of Using TiO_2 Barrier in Recovering Plasma Induced Damage in PZT Capacitors by Annealing
K. Ishihara et al

The ISIF 95 papers on
- **Special Session on Layered Perovskites**
- **DRAMs**
- **Modeling and Theory**
- **Poster Session**

will be published in the next issue.

Starting with the Fall 1995 issue,
Ferroelectricity Newsletter
will be available through
World Wide Web.
See the editorial for further details.

JOURNALS

UPDATE ON PROFESSIONAL JOURNALS

Two years ago, in the Spring 1993 (Vol. 1, No. 2) issue of the ***Ferroelectricity Newsletter***, we gave a short summary of the Gordon and Breach family of journals on ferroelectrics. Today we want to give you some information on several other professional journals on ferroelectrics or related fields.

Sensors and Materials

This journal is designed to provide a forum for people working in multidisciplinary fields of sensing technology. It publishes contributions describing original work in the experimental and theoretical fields, aimed at the understanding of sensing technology, related materials, associated phenomena, and applied systems. Expository or review papers and short notes are also acceptable.

The editor is **Tetsuro Nakamura** of Toyohashi University of Technology, assisted by associate editors **Henry P. Baltes** of the Swiss Federal Institute of Technology and **Richard S. Muller** of the University of California, Berkeley.

Manuscripts and all correspondence should be addressed to ***Sensors and Materials***, Scientific Publishing Division, MYU 2-32-3 Sendagi, Bunkyo-ku, Tokyo 113, Japan. Phone +81 3 3821-2930, Fax +81 3 3827-8547

Topics

- Optical sensing
- Temperature sensing
- Humidity sensing
- Electromagnetic sensing
- Pressure sensing
- Acoustic sensing
- Mechanical sensing
- Gas sensing
- Biological sensing
- Remote sensing
- Nuclear sensing
- Materials for sensor technology

To give you a better idea of the journal's scope, here is a list of the research reports published in Vol. 7, No. 3, 1995:

Spatiotemporal Dynamics of Glycolysis and Cellular Metabolism: Toward Intelligence by Nonlinear Chemical Processes by*Tetsuo Ueda*

Information Transduction in Slime Molds and Its Application to Biosensing by *Masayasu Suzuki, Shuichi Takahashi, Masahiro Ishibashi, and Kiyohisa Natsume*

Simultaneous Sensing of Five Compounds in Fruit by Amperometric Flow Injection System With Immobilized Enzyme Reactors by *Kiyoshi Matsumoto, Tadayuki Tsukatani, and Seiichi Higuchi*

Environmental Chemical Sensing Using Quartz Microbalance Sensor Arrays: Application of Multicomponent Analysis Techniques by *Andreas Hierlemann, Udo Weimar, Gerolf Kraus, Günter Gauglitz, and Wolfgang Göpel*

Quantitative Sensing of Mineral Water With Multichannel Taste Sensor by *Satoru Iiyama, Miki Yahiro, and Kioshi Toko*

Sensing of Chemical Substances Using Light-Induced Potential Changes of Organic Membranes by *Kenshi Hayashi*

Intelligent Three-Dimensional Vision Sensor With Ears by *Shigeru Ando*

Phase Transitions

This multinational journal is the only one devoted exclusively to this fast growing subject. It provides a focus for papers on most aspects of phase transitions in condensed matter. Although emphasis is placed primarily on experimental work, theoretical papers are welcome if they have some bearing on experimental results. The areas of interest include structural (ferroelectric, ferroelastic, high-pressure, order-disorder, Jahn-Teller, martensitic, etc.) phase transitions, geophysical phase transitions, metal-insulator, superconducting, and superfluid transitions, critical phenomena and physical properties at phase transitions including those of liquid crystals, and technological applications of phase transitions.

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JOURNALS

PROFESSIONAL JOURNALS -- continued from page 9

Major review papers are particularly welcome but the editors also welcome timely primary research papers on all the above areas. Papers should be sent to the regional editors at the addresses given.

Phase Transitions regularly publishes whole issues devoted to special topics for which a guest editor is appointed. The guest editor is responsible for inviting authors to contribute, as well as for the acceptance of papers. Guest editors receive a fee for their services.

The editor-in-chief and regional editors welcome proposals for special issues. Anyone interested in preparing such an issue should contact the editor-in-chief or one of the regional editors for details.

Recent special issues were published on the following subjects:

- Dynamical Aspects of Fluid Phases *(Eds. S. Dattagupta, S. Puri, and V. K.Wadhawan)*
- Martensitic Reconstruction *(Ed. Y. A. Izyumov*
- Mobile Domain Boundaries *(Ed. E. K. H. Salje)*
- Phase Transition and Related Problems in Polymer Gels *(Ed. S. Hirotsu)*
- Rhythm, Oscillations, and Phase Transitions in Biophysical Phenomena *(Ed. S. Ishiwata)*
- Ferroelasticity *(Eds. V. K. Wadhawan and V. Janovec*

Editor-in-Chief

A. M. Glazer, Clarendon Laboratory, University of Oxford, Parks Road, Oxford, OX1 3PU, UK

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J. Fousek, Institute of Physics, Academy of Sciences, Na Slovance 2, 180 40 Prague 8, Czech Republic

S. Shapiro, Physics Department S10B, Brookhaven National Laboratory, Upton, NY 11973, USA

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V. K. Wadhavan, Crystal Growth Laboratory, Centre for Advanced Technology, Indore 452013, India

Condensed Matter News

This journal, published bimonthly by Gordon and Breach Science Publishers, features ferroelectrics, molecular crystals and liquid crystals, phase transitions, and nonlinear optics. In it the reader finds news, meeting reports, overviews, reports on new products, book reviews, and a calendar of events. Of special interest is a center pullout section with abstracts of papers appearing in concurrent issues of the journals ***Ferroelectrics, Integrated Ferroelectrics, Molecular Crystals and Liquid Crystals, Comments on Condensed Matter Physics, Nonlinear Optics*** and ***Phase Transitions.***

The March/April 1995 issue, for example, lists 155 abstracts of papers which will appear in a special issue of ***Ferroelectrics*** on the **8th International Meeting on Ferroelectricity** to be held 4 - 8 July 1995 at the University of Nijmegen in The Netherlands.

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UPCOMING MEETINGS

5th International Conference on Ferroelectric Liquid Crystals (FLC 95)
24 - 27 July 1995
Cambridge, England

The conference is the fifth in a series of biennial international meetings where advances and recent developments in the field of ferroelectric and related liquid crystals are discussed.

The program will consist of single sessions of invited lectures with contributed oral and poster presentations.

Sessions

- Device applications (neural networks, optical computing, correlators, beam steering, tunable filters, etc.
- Device technology - displays
- Device technology - SLMs
- Addressing and switching
- Electrooptics
- Linear and nonlinear optics
- Polymeric FLCs
- Alignment, liquid crystal structures and defects
- Chiral systems (including other chiral phases and lyotropics)
- New materials
- Phases and phase transitions
- Antiferroelectrics
- Microscopic (studies using FT-IR, NMR, etc.)
- Theory

Conference Co-Chairmen

Prof. W. A. Crossland, Northern Telecom Research, Professor of Photonics, Department of Engineering, University of Cambridge, Cambridge, CB2 1PZ, UK, phone +44 223 330264, fax +44 223 332662, e-mail wac@eng.cam.ac.uk
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First Asian Meeting on Ferroelectrics (AMF-1)
5 - 8 October 1995
Xi'an, China

This international meeting is under the auspices of the Electronic Components Society, the Sensor Technology Society, the Chinese Institute of Electronics, and the Asian Ferroelectric Association (AFA).

Topics

- Fundamental phenomena of ferroelectrics
- Dielectric, piezoelectric, pyroelectric, and ferroelectric materials
- Crystal, ceramic, polymer, liquid crystal, glass and amorphous systems, composites
- Fine particle, fiber, thin film
- Electrical, optical, and nonlinear optical behaviors
- Dielectric applications
- Sensor, transducer, and actuator applications
- Integrated ferroelectrics

Contact

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CALENDAR OF EVENTS 1995

Jul 3-5	• 1st European Meeting on Integrated Ferroelectrics (EMIF1), Nijmegen, The Netherlands (see *Ferroelectricity Newsletter* Vol. 3, No. 1, p. 27)
4-8	• 8th European Meeting on Ferroelectricity, University of Nijmegen, The Netherlands (see *Ferroelectricity Newsletter* Vol. 3, No. 1, p. 26)
24-27	• 5th International Conference on Ferroelectric Liquid Crystals (FLC 95), Cambridge, England (see p. 11)
Aug 26-29	• 56th Autumn Meeting of the Japan Society of Applied Physics, Kanazawa Institute of Technology, Kanazawa City, Japan. For information contact the Japan Society of Applied Physics. For information contact The Japan Society of Applied Physics, Kudanshita Building, 1-12-3 Kudan-kita, Chiyoda-ku, Tokyo 102, phone +81 33 238 1044, fax +81 33-221 6245
Oct 5-8	• First Asian Meeting on Ferroelectrics (AMF-1), Xi'an, China (see p. 11)
Nov 27-**Dec** 1	• MRS 1995 Fall Meeting, Boston, MA. For information contact: Michael J. Aziz, Harvard University, phone (617) 495-9884, fax (617) 495-9837, e-mail aziz@das.harvard.edu; Berend T. Jonker, Naval Research Laboratory, phone (202) 404-8015, fax (202) 767-1679, e-mail jonker@anvil.nrl.navy.mil; Leslie J. Struble, University of Illinois-Urbana, phone (217) 333-2544, fax (217) 333-9464, e-mail istruble@civilgate.ce.uiuc.edu
	1996
Aug 18-21	• IEEE International Symposium on the Application of Ferroelectrics (ISAF '96), Brunswick Hilton and Tower, East Brunswick, NJ/Rutgers University. For information contact Prof. A. Safari, Rutgers University, Dept. of Ceramic Engineering & Center for Ceramic Research, PO Box 909, Piscataway, NJ 08855-0909, phone (908) 445-4367, fax (908) 445-3258, e-mail safari@safari.rutgers.edu

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