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Ferroelectricity Newsletter

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

Volume 3, Number 3

Summer 1995

DO YOU WANT TO GET THE NEWSLETTER THROUGH WORLD WIDE WEB OR BY MAIL?

As we announced in our last editorial, starting with the Fall 1995 issue, the *Ferroelectricity Newsletter* will be available on World Wide Web. To access it, you need the following URL of the ferroelectricity home page at the Space Systems Academic Group:

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

The newsletter will be available on World Wide Web on the following dates:

Fall issue - 15 October
Winter issue - 15 January
Spring issue - 15 April
Summer issue - 15 July

What do you have to do if you want to continue receiving the newsletter by mail?

Inform us by 15 September 1995 that you want to get the newsletter by mail. We have already received numerous requests to this effect. You can reach us as follows:

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

I am sure you will be just as delighted as I am to read the third installment of **Professor Cross's history of ferroelectricity** -- valuable information packaged in a unique combination of wit and humor.

A big part of this issue is again devoted to lists of papers delivered at conferences: the second part of ISIF 95 presentations and the papers given at the 2nd International Conference on Space Charge in Solid Dielectrics. In the section Conference Reports, **Dr. Friedemann Freund** writes about **CSC'2**, **Professor Y. Ishibashi** informs us about **FMA-12**, and **Professor Takeshi Egami** brings highlights of the **ONR Workshop** held in Williamsburg.

You will also find three short announcements which might be of interest to you: on page 6 we mention the **1995 MRS Publications Catalog Supplement**; on page 7 there is a note about the **study of ferroelectricity in the former Soviet republics**; and on page 15 we refer to a **Bibliography of Ferroelectrics**.

Last but not least, I want to thank you for the many expressions of appreciation of this publication we received during the last few weeks.

Rudolf Panholzer
Editor-in-Chief

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Ferroelectricity Newsletter

Volume 3, Number 3
Summer 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*(continued from last issue)*

In the Spring issue we listed the 1995 papers on

- *Materials Processing - CVD*
- *Applications and Devices: Microwave and Diverse Nonvolatile Memory Optical and Pyroelectric*
- *Characterization and Testing*
- *Device Processing and Integration*

delivered at the 7th International Symposium on Integrated Ferroelectrics held in Colorado Springs, Colorado, 20 - 22 March 1995.

In this issue we bring you the titles and authors of papers of the remaining sessions:

- *Special Session on Layered Perovskites*
- *DRAMs*
- *Modeling and Theory*
- *Poster Session.*

Guest editor of the ISIF 95 proceedings, to be published in Integrated Ferroelectrics., is Angus I. Kingon.

Special Session on Layered Perovskites

Systematics of Bismuth Layer Compounds

E. C. Subbarao

Structural and Electrical Characterization of SrBi₂Ta₂O₉ Thin Films

Y. Miyasaka et al

Characteristics of Low Temperature Annealing SrBi₂Ta₂O₉

T. Ito et al

Spin-On Processed Conductive Oxide Electrodes, Lead-Based Perovskite as Well as Layered Perovskite Films

M. Klee

--continued on page 3

HISTORY**FERROELECTRICITY: The Golden Years**

L. Eric Cross

Evan Pugh Professor of Electrical Engineering
Materials Research Laboratory
The Pennsylvania State University
University Park, PA 16802-4800

In the early 1970s, it was becoming abundantly clear that the growing ferroelectric community in the Materials Research Laboratory at Penn State was in urgent need of a new initiative (meaning an improved source for that vital crinkling green lubricant). **Bob Newnham and I were both loaded with new ideas on piezoelectrics**, following from our earlier studies for World Research, so we sat down and with help from all in the group wrote what we thought was a cracker-jack proposal for an ONR program on transducer materials. Imagine our chagrin when on trying to discuss our ideas with Arthur Diness (an old Penn State MRLer), we were almost laughed out of court. "Eric, you are going to teach your grandmother how to suck eggs!" "The US Navy almost invented piezoelectric transducers, we know all the wrinkles in that field." "It's a truly mature technology, etc., etc., etc." Talk about tail between legs as we quietly snuck away -- like most university professors naive and overenthusiastic.

But life goes on! I was program chair for **ISAF-3 in Albuquerque** and following that meeting had an invitation to participate in the **Second US - Japan Meeting on Ceramics in Hakone**. By coincidence there had been a recurring problem with insulators holding up one of the mile high ULF transmitter towers on Oahu. Arthur Diness held a meeting in Washington, DC, to consider the problem, and on hearing I would be coming back from Japan through Oahu, asked if I would stop in and have a "look see." No problem, there was a chief petty officer on the base who would give all details and take me out to the tower, and besides who wouldn't want a few extra days in Hawaii? As the time came up for ISAF-3, I was in quite a tizzy. Mrs. Cross had been diagnosed as needing an urgent operation on her throat, with the minor chance of a malignancy, and I would necessarily be away. I packed in a rush and got away, but my mind was not with the meeting until on the second day, Rustum Roy, our lab director, called to say that the operation went fine and all was well.

That evening I headed to the bar with the firm intention to get plastered. At the bar, however, I met up with a participant, a newcomer to the field who was intrigued by ferroelectricity and began asking what was new. Nothing daunted, I fished out a copy of our spurned proposal for him to read. The young man was Richard Reynolds, who had just joined DoD's ARPA (Advanced Research Projects Agency). He took the document, said he would call me when I got back from Japan (and he did).

The Hakone Meeting in Japan was organized by Richard Fulrath, and even though he was a piezoceramic PZT processor, we had not been close friends.

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HISTORY

FERROELECTRICITY: The Golden Years -- continued from page 2

I liked Dick a lot and was deeply shocked when he took me into his confidence that he knew for sure he was dying of lung cancer. I agreed to pick up the pieces if he could not finish the meeting.

Fortunately his health held up very well and we were able to go on together to the **Japan Defence Academy with Kiyoshi Okazaki**. I remember vividly the fantastic welcome party at the Academy, where Fulrath was a very well-known and well-loved character. Kiyoshi was well aware of the work of the Penn State group on dielectrics and ferroelectrics, but wanted to know some of the more personal background. Fortunately I had a recent photograph of my family, but wondered whether to show it, since we were a little diverse even by American standards. Lucilla and I have six children, three original English, three American -- four white and two black (our two adopted daughters). The photo produced an absolutely flabbergasted reaction from our Japanese hosts. I think the basic surprise was how could the "elders" in our families have permitted, even encouraged, such diversity. But the Academy was an enthusiastic and forgiving group, so I went on to have many further delightful visits there.

On the way back to State College, I stopped off on Oahu at the old Pink Palace (the original Sheraton) but there disaster struck. I searched high and low through my bags but had not packed the ONR data for the visit! How to find one CPO in the thousands in the dockyard? Impossible, so once again I repaired to the bar to contemplate options! Then perhaps the longest shot coincidence of my whole life occurred. Looking across the bar, I thought I recognized a "Washington" face, one of the men who had been at the Diness meeting in ONR. Sure enough, he had been at that meeting and had all the data with him. The unbelievable thing was that he had been on his way to New Zealand, when the plane had trouble and was diverted to Oahu. He just had enough time before they were off again to come down to Waikiki Beach for dinner and by pure chance had picked the Sheraton for a pre-dinner drink! I have always been a very lucky man, but this was something else!!! The trip to the tower went well and we were able to diagnose some corrective actions.

Back in State College I got the unexpected telephone call. Dr. Reynolds had read our proposal, liked it a lot, and was prepared to co-fund, pushing ONR to start us up.

Interestingly, **one of our concepts related to the piezoceramic/polymer composite structures, where we believed we could tailor and control tensor properties for large area hydrophone sensors.**^(1,2) **Within three years we had new research materials which raised the hydrophone figure of merit (d_{hg}) by two orders of magnitude**, and before our first three-year contract ended, the Navy asked us to submit for a competitive five-year "Center of Excellence" Grant in Transducers, and the Lab is even now still going strongly in that field.⁽³⁾

In connection with the original ARPA funding, Dick Reynolds asked me to set up a one-day review of transducer materials at the Materials Research Council (MRC) meeting in La Jolla. I guess the group must have liked what

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ISIF 95 PAPERS

cont.

Pulsed Laser Ablation Synthesis and Characterization of $\text{SrBi}_2\text{Ta}_2\text{O}_9/\text{Pt}$ Ferroelectric Capacitors

R. Dat et al

Characteristics of Some (MOD) Thin Film Layer Type Compounds in the Bismuth Titanate-Lead Titanate System

A. L. Micheli et al

Stoichiometry Control of Spin-On $\text{SrBi}_2\text{Ta}_2\text{O}_9$ Ferroelectric Thin Films

V. Joshi et al

Novel Fatiguefree Ferroelectric Thin Films Made by Metalorganic Deposition (MOD) Technique

T. Li and S. B. Desu

Electrical Characterization of Y-1 Thin Films for Ferroelectric Non-volatile Memory

R. E. Jones, Jr. et al

Preparation and Characterization of Y-1 Capacitors by Misted Deposition Technique

S. Hayashi

Stages in the Annealing of $\text{SrBi}_2(\text{Ta}_x\text{Nb}_{1-x})_2\text{O}_9$ Thin Films

T. K. Li et al

Superior Electrical Characteristics of Bilayered Perovskite Thin Film and Comparison With PZT

T. Mihara et al

High Remnant Polarization Layered Perovskites for High Density Memory Applications

M. Azuma and C. Paz de Araujo

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ISIF 95 PAPERS

cont.

Design of Firm-Type NDRO
Memory

J. Drab et al

DRAMs

High Dielectric Constant Materials
for DRAM

S. R. Summerfelt et al

Integration of BST Thin Film for
DRAM Fabrication

H. Itoh et al

Electrical Properties of the Barium
Strontium Titanate
(Ba_{0.5}Sr_{0.5}TiO₃) Thin Films
Deposited on Various Pt-Base
Electrodes

W.-J. Lee and H.-G. Kim

Sputtered and CVD Pt Electrodes
for DRAM Applications

R. Tsu et al

Effects of Interfacial Roughness on
the Leakage Properties of SrTiO₃
Thin Film Capacitors

Y. Fukuda et al

Electrical Characteristics of Mn
Doped Thin Film BST

Y. Oishi

Electrical Characteristics of CVD
Deposited Bismuth Strontium
Titanate Films

T. S. Kalkur et al

Electrical Characterization of PLT
Thin Films by LP-MOCVD

S.-S. Lee and H.-G. Kim

A Gbit-Scale DRAM Stacked
Capacitor With ECR MOCVD
SrTiO₃ Over RIE Patterend RuO₂/
TiN Storage Nodes

P.-Y. Lesaicherre et al

HISTORY

FERROELECTRICITY: The Golden Years -- continued from page 3
we were doing, because now, some nineteen years later, I sit on the follow-
on to MRS, the Defense Sciences Research Council (DSRC).

It is interesting how odd events can trigger whole new areas of research. At MRC it was my privilege to meet with Gordon Kino, then one of the resident experts on ultrasonic nondestructive testing. Gordon had a puzzle for me! During one of his sequences of experiments one of his more "ham-handed" grad assistants knocked the electronics into the water bath and to their profound astonishment they found that **the Erie technological blocking capacitor, a multilayer high K ceramic, was generating more signal than the PZT transducer.** How could this be?

Being a phenomenologist, I first went back to Devonshire, we knew the permittivity, the Curie point, the bias voltage, and electrostriction constants for BaTiO₃. Sure enough, the induced strain levels at his AC driving were comparable to PZT. Since MLC technology is so widespread, we thought we ought to explore further. At this time we had **Professor Nomura**, and old friend of Newnham's, **working with us in the Lab, and together with my student Sei Joo Jang he began the studies** ^(4,5) **which led to the evolution of the lead magnesium niobate electrostrictive ceramics.** It just proves the contention that most advances occur by accident and points up the importance of having accident prone assistants in the research chain.

Due to our funding huff and puff with Wright Patterson AFB, I missed the IMF Meeting in Edinburgh, Scotland, so I was determined to plan and execute a more extensive itinerary for the **IMF-4 in Leningrad** (now St. Petersburg). We flew in through Helsinki and that was one truly exciting meeting. A chance to meet again with the great actors in Russian ferroelectricity -- Shuvalov, Smolensky, Alexandrov, Lemonov, Fridkin My wife and I were surprised to find ourselves separated from the main US party and housed in the elegant old Astoria Hotel downtown. This was the hotel where Adolf Hitler had planned to have his victory celebrations after conquering St. Petersburg. Fortunately for us all, that victory never happened.

What an experience it was to give a paper in the very same lecture theater where that rascal Rasputin had held court. Surprisingly there was much admiration for that tough old peasant, who was reputedly poisoned, stabbed, and then pushed under the ice in the river where apparently he died by drowning!

It was in Leningrad that I was first asked by Alastair Glass and Issai Lefkowitz to participate in the selection dinner for the site of IMF-5. I was still sufficiently naive to be surprised when the lot fell to USA with Penn State as the proposed site. Following the Prague, Kyoto, Edinburgh, and Leningrad meetings, all scintillating sophisticated major cities, I was clear that we would need all the help we could get.

Following Leningrad, I was able to visit Riga in Latvia, Moscow, and Prague before returning. It was a truly humbling experience to walk with Andris Brocks along the impressive Avenue of Remembrance to the War Memorial in Riga. The horrors of war truly strike home when you are in a

HISTORY

FERROELECTRICITY: The Golden Years -- continued from page 4

small country which lost almost half its population, and the tragedy could be palpably felt as we walked. But the human spirit is remarkably buoyant, and I can still remember our US party seeing Charlie Pulvari and his charming daughter off from Kievsky Station in Moscow for his first trip to his home in Hungary and lightheartedly trying to shoot out the station lights with champagne corks to the approving applause of a party of Soviet soldiers.

The next banner year for ferroelectrics was in **1979 with the ISAF meeting** in Minneapolis, chaired by Mike Liu, followed by the first **NATO Workshop on Ferroelectricity in Erice, Sicily, in 1980**. My recollection of ISAF-4 is colored by the fact that at Penn State we had just made strongly electrostrictive lead magnesium niobate:lead titanate, which we reported at the meeting, and had made effective contact with Ralph Aldrich's group at ITEK, who needed this material for surface deformable atmosphere correcting mirrors. Minneapolis is a pleasant city, the downtown Sheraton was most comfortable, and we had a lovely "steamboat" excursion on the river.

The ferroelectric workshop in Erice was quite outstanding. Firstly, if you want to run a workshop which retains the group in close contact, I strongly recommend locating it on the very top of an extinct volcano in Sicily. In any short walk from the conference center, the loss of potential energy (hg) soon convinced you that it was wise to stay close to home. The second major advantage was the presence of a large barrel of good sherry in each conference room. This led to open, almost voluble discussion at each session, a noticeable advantage for the meeting.

The side trips from Erice were always exciting starting with either a bus trip around all the hairpin bends down the mountain, or a trip down in a cable car to the seaside. To visit one Greek temple we had to cross to a small island off the coast, and the ferroelectric community embarked in a rickety old fishing boat. I had the vision of all being lost at sea, but was vastly reassured to find the bottom was only eighteen inches below the keel of the boat for the whole half mile trip. In the village, we came across a local ceramics shop with quite the most ghastly panoply of pots, vases, figurines, and prancing horses on display. Poor Dr. Wood moved in close to look through the window, and the whole erection of outside shelves came crashing down. I swear it was booby trapped! Unfortunately it cleaned out poor Wood, and we had to have a collection in the bus to restore solvency.

From Erice I was able to go on to spend a three-month sabbatical at the Plessey Laboratories in Towcester, Northampton, in England. The topic of interest was lead scandium tantalate (PST). Back in MRL, **Nava Setter had just completed her elegant studies of order-disorder in PST,⁽⁶⁾ a major forward step in understanding relaxor behavior**, but also leading to a composition in which one could trim the location of the dielectric maximum without incessant composition manipulation, an interesting composition for long-wave IR detectors and imagers.

The run-up to the IMF-5 in State College occupied us for much of 1981 and was greatly helped by Issai Lefkowitz, who was meeting chair, and by a

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ISIF 95 PAPERS

cont.

Modeling and Theory

Fundamental Current-Voltage and Capacitance-Voltage Relations of Polarized Ferroelectric Thin Film Devices

R. Zuleeg et al

Dielectric Response of Ferroelectric Thin Films

M. Sayer et al

Improved Equivalent Circuit Model of Ferroelectric Thin Film Capacitor

S. Xiong and X. Yao

Ferroelectric -Monolayer Reconstruction of the SrTiO₃ (100) Surface by Computer Simulation

V. Ravikumar et al

Dynamics of Ferroelectrics Above and Below the Critical Temperature

A. Bussmann-Holder

Optical Nonlinear Effects of Thin Ferroelectric Films Near the Curie Point

A. S. Carrico

POSTER SESSION

CVD

Preparation and Characteristics of Ferroelectric Pb(Zr_xTi_{1-x})O₃ Thin Films by Remote Plasma MOCVD

H.S. Song et al

Microwave

Fabrication and Performance of Coplanar Ferroelectric Phase Shifter

W. Wilber et al

Sol-Gel

Orientation Effects on the Hysteresis Properties of Sol-Gel and Laser-Ablated Lead-Zirconate-Titanate (PbZr_xTi_{1-x}O₃=PZT Thin Films

D.J. Wouters et al

Effects of Yttrium Addition on the Ferroelectric Fatigue Characteristics

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ISIF 95 PAPERS

cont.

of $\text{PbZr}_{0.65}\text{Ti}_{0.35}\text{O}_3$ Thin Films
Prepared by Sol-Gel Processing

J.H. Kim et al

Optical

Measurement of Electrooptic
Properties of Ferroelectric Thin
Films

G. Teowee et al

Sol-Gel Derived La-Doped TbTiO_3
Waveguides

G. Teowee et al



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HISTORY

FERROELECTRICITY: *The Golden Years* -- continued from page 5

very strong and distinguished program committee. A last minute problem which almost "derailed" us was produced by President Reagan, who about a month before our meeting fired all the air traffic controllers! Fortunately international flights did come back quite quickly, but all local commuter flights were shut down. We had to lay on emergency bus service to New York, Washington, and Pittsburgh, which surprisingly worked very well.

In organizing a social event for the meeting, clearly we could not compete with the glamor of a capital city, so we decided to run a barbeque at Stone Valley, the University's outdoor recreation park. To make best use of the lake in the park, we sponsored an international canoe race. It was near disaster, when the Indian team canoe turned over. Fortunately the canoes had good flotation and all got back safely! We rounded out the afternoon with a good old American square dance.

About this time, with the termination of the cultural revolution in China and the exit from the political scene of the gang of four, we began to get our first visitors from China. Dr. Yao Xi was the first to join our group followed by Chen Zili, Chen and Xu, so that soon we had our own gang of four!

It was most interesting to hear of the manner in which they had all survived periods in the countryside working in remote communes and to see the spirit and enthusiasm with which they tackled the new challenges of work at the University here. Yao Xi had begun his graduate studies before the cultural revolution under Russian tutelage. He decided to take a PhD with me, and was, I believe, the first student in the new influx from China to achieve a degree in the USA. His work was in fact recognized by the Ross Coffin Purdy Award of the American Ceramic Society.

In 1983, I was honored to be invited to participate in the first US-China meeting on ceramics to be held in Shanghai. We decided to go a little early for the meeting and Mrs. Cross and I were joined by Don Smyth from Lehigh, who was also to be a participant. It was a great pleasure to be escorted throughout our trip by Yao Xi and Chen Zili. We visited and lectured in Beijing, Nanjing, Shandong, West Lake, and Shanghai.

At West Lake we stayed in the summer residence of the real gang of four, and our building had been the residence for Lin Piao, very comfortable and not the egalitarian image often portrayed.

Following our trips ahead of the meeting we spent a week in Shanghai discussing topics in both structural and functional ceramics, then the whole group went on by train to Loyang and Xi'an.

Loyang is the center of China's glass and ceramic manufacturing. The river cuts through huge thick clay beds, and at that time one could see the entrance to whole underground villages carved out in the clay. We visited the excellent refractories laboratory in Loyang and a huge float glass processing plant.

In Xi'an I was in the new downtown hotel. It was so new that they had not had time to couple the waste pipes onto the wash basins which thus

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HISTORY

FERROELECTRICITY: The Golden Years -- continued from page 6 emptied straight onto the floor. Fortunately that was tiled and did have its drain connected. At that time plumbing was not a forte of the construction industry in China, and I think on the round trip I fixed some five ball valves to stop needless waste of water!

From Z'ian we flew down to Canton for brief visits to Sun Yat-sen University and to the South China Institute for Science and Technology (SCIT), both of which institutions had had students at Penn State/MRL.

We returned through Hong Kong just in time for ISAF-5 in Washington, DC, but that must wait for the last installment of this saga.

References

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3. ONR Annual Report, "Materials for Adaptive Structural Acoustic Control," Volumes I-IV (February 1, 1994, to January 31, 1995).
4. S.J. Jang, K. Uchino, S. Nomura, and L.E. Cross, "Electrostrictive Behavior of Lead Magnesium Niobate Based Ceramic Dielectrics," *Ferroelectrics* (1979 IEEE Int. Symp. Appl. Ferroelectricity, Part I) 27 (1-4), 31-34 (1980).
5. S. Nomura, J. Kuwata, K. Uchino, S.J. Jang, L.E. Cross, and R.E. Newnham, "Electrostriction in the Solid Solution System Lead Magnesium Niobium Oxide-Lead Magnesium Tungsten Oxide ($Pb(Mg_{1/3}Nb_{2/3})O_3$ - $Pb(Mg_{1/2}W_{1/2})O_3$)," *Phys. Status Solidi A* 57 (1), 317-21 (1980).
6. N. Setter and L.E. Cross, "The Role of B-Site Cation Disorder in Diffuse Phase Transition Behavior of Perovskite Ferroelectrics," *J. Appl. Phys.* 51 (8), 4365-4360 (1980). □

Special Issue of *Ferroelectrics* (Vol. 167, Nos. 3-4, 1995) on INVESTIGATIONS IN THE COMMONWEALTH OF INDEPENDENT STATES (CIS) ON

Ferroelectrics and Related Materials: Their Design, Processing, and Application

Guest edited by Sidney B. Lang, Yu.N. Venevtsev, and Yu.Ya. Tomashpolsky, most of the 22 reviews and original papers were presented at the Fourth Commonwealth of Independent State (CIS) Conference, held in Moscow in 1992 under the sponsorship of the Karpov Institute of Physical Chemistry, attended by about 350 scientists and engineers from the former Soviet republics. Many of the review papers contain material previously only available in Russian. Here they are published in English for the first time. This special issue of *Ferroelectrics* will help acquaint ferroelectric researchers in the world with the achievements of the scientific community of the CIS.

For ordering information see page 15 of this issue.

CSC'2 PAPERS

The following papers were delivered at the 2nd International Conference on Space Charge in Solid Dielectric Materials, which took place from 2 - 7 April 1995 in Antibes, France. (See also page 8 for a report on the conference.)

Influence of Space Charges on the Short and Long Term Performance of Solid Dielectrics

R. Bartnikas

Les Limites des Mesures des Charges d'Espace sur la Caractérisation du Vieillessement des Isolants Polyéthylène des Câbles d'Energie

R. Clavreul and X. Bourgeat

Noise as a Possible Diagnostic Tool for Characterization of Solid Dielectrics

R. Alabedra

Conduction Mechanics and Space Charge Effects in Typical Thin Film Insulators (SiO_2 , Ta_2O_5 , $PbZr_xTi_{1-x}O_3$)

J.L. Autran, P. Paillet, J.L. Leray, and R.A.B. Devine

Real Time Imaging Studies of Prebreakdown and Breakdown Processes in High Voltage Gaps

R.V. Latham, N.S. Xu, and B.M. Coaker

Breakdown Phenomena in RF Windows

Y. Saito, S. Michizono, A. Inagaki, and H. Kawai

Effect of Space Charge on the Friction Behavior of Dielectric Materials

S. Fayeulle, D. Treheux, J. Bigarre, J. Vallayer, and G. Blaise

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CSC'2 PAPERS*cont.*

Capacitors: Aging and Failure - A Review

W.J. Sarjeant

Relations Between Electric Break-down Field and Mechanical Properties of Ceramics

S. Carabanjar, O. Olagnon, G. Fantozzi, and C. le Gressus

Contact Electrification Effects on Interfacial Crack Opening Profiles

K.M. Liechti, Y.M. Liang, and J.G. Swadener

Acoustic Wave Generation and Mechanical Fracture of Solid Dielectrics Under the Action of Single Pulse and Repetitive High Current Density Electron Beams

A. Bardenstein and D. Vaisburd

Critical High-Power Electron Emission From Dielectric Induced by High-Density Electron Beam Injection

S. Twerdokhlebov and D. Vaisburd

Nonlinear Physics of Solid Dielectrics Charging-Discharging Dynamics Under the Action of Pulsed High Current Density Electron Beams

D. Vaisburd

Generation of Nuclear Products in KD_2PO_4 Single Crystals Upon the Ferroelectric Phase Transition

A.G. Lipson, D.M. Sakov, I.J. Bardishev, E.I. Saunin, and B.V. Derjaguin

Electronic and Defect Processes in Oxides: The Polaron in Action

A.M. Stoneham

CONFERENCE REPORTS**SECOND INTERNATIONAL CONFERENCE ON SPACE CHARGE IN SOLID DIELECTRICS (SCS'2)**

Just before Easter, before the tourists would start crowding the town and populating the beaches, the **Second Conference on Space Charge in Solid Dielectrics**, CSC'2, was held 2 - 7 April 1995 at Antibes – Juan-les-Pins on the French Mediterranean coast, the "Côte d'Azur". This small resort town traces its origins back to the ancient Greeks who founded it before the Roman empire took centerstage in European history. At that time Nice was an important merchant city, establishing links between Greece and the mountainous coastal region, renowned today for its good fruits, fair wines, and flower fragrances used in French perfumes. Facing Nice, at the site of a small, rocky harbor, the Greek built "Antipolis", the "Opposite City", which evolved into today's name Antibes.

Organizer of the CSC'2 was the **French Vacuum Society** in collaboration with **ASPROM**, the "**Association pour la Promotion des Micro-technologies**," and support from **IEEE, Dielectrics and Electrical Insulation Society**. The medium-sized meeting was held in the Convention Center in the heart of Juan-les-Pin, the most fashionable part of Antibes. In venerable French tradition the timetable called for long lunch breaks. However, those breaks were mostly shorter than advertised because, more often than not, the session chairs did not hold speakers and discussion participants to strict time discipline. The good side of this wonderful French "laissez-faire" was that long, vivid and often colorful discussions ensued which were instructive in their own rights. Evenings were used to arrange for various committee meetings where good food and wine competed with serious discussions. And of course, there was an afternoon trip to the countryside, up steep mountains, to see fortified villages perched on hilltops, to visit a family-run dried fruit, jam and chocolate factory in a deep gorge, and to end the day with a lengthy dinner where some conference participants joined the music band in a hilarious impromptu talent show.

The topic of the meeting was to ask WHEN, WHERE and HOW do spaces charges manifest themselves in dielectric media and what kind of MISCHIEF they are able to do.

The program contained a well-balanced mix of papers addressing fundamental and applied issues. Many, if not most of the speakers were French, giving an excellent first-hand account of the numerous interesting research projects underway in France. Other distinguished speakers and participants came from nearby Italy, Algeria, Canada, China, Belgium, England, Germany, Holland, India, Ireland, Japan, Latvia, Poland, Romania, Russia, Singapore, Switzerland, Tunisia, Ukraine, and the USA.

The oral presentations - no parallel sessions - were divided into three main sessions, dealing respectively with **(I) break-down and emission phenomena, conduction mechanisms in oxides, and crack formation, (II) polarons, charging, self-trapping, and aging, and (III) characterization of space charges**. The poster session was well organized and allowed for ample viewing and discussion time. The properties of many materials were addressed, ranging from polyethylene for high tension power transmission

CONFERENCE REPORTS

CSC'2 REPORT -- continued from page 8

lines, other polymers like polyimide, fused silica and sapphire for windows in high energy electron or particle beam laboratories, magnesium oxide and ferroelectrics, to thin-film silicon oxide in MOS and nonoxide insulators like silicon nitride in MNOS structures.

The conference proceedings with some 85 papers in a 690 pages thick softcover volume had been published prior to the conference by the French Vacuum Society, Société Française du Vide, 19 rue due Renard, F-75004 PARIS, France, with a price tag of FF 990.

Friedemann Freund
NASA Ames Research Center and Phytron Instruments, Inc.
Mountain View, California

THE TWELFTH MEETING ON FERROELECTRIC MATERIALS AND THEIR APPLICATIONS

The Twelfth Meeting on Ferroelectric Materials and Their Applications (FMA-12) with **General Chairman A. Kawabata**, Toyama Prefecture University; **Program Chairman Y. Ishibashi**, Nagoya University; and **Executive Chairman T. Shiosaki**, Kyoto University, was held 24 - 27 May 1995 at Coop-Inn Kyoto, Kyoto. The FMA has been held every year since 1992, until then once every two years. About 300 participants from academic and industrial communities, including about 10 from overseas, attended the meeting, where 105 ten-minute lectures, selected from about 135 proposals, were given in 18 plenary sessions, some presented in English. The invited talk was given by **Dr. Fujishima**, Murata Manufacturing Company, who reported on the **history of his research in piezoceramics**.

FMA covers all application aspects of ferroelectric materials. A notable trend in recent years, however, is the increasing number of contributions on thin films, which numbered 46 this year. Piezoelectrics, materials and applications, is another field of growing interest, with 21 lectures delivered on this subject.

The lectures given at FMA-12 will be published as regular papers in a special issue of the *Japanese Journal of Applied Physics* in September (JJAP Vol. 35, No. 9B, 1995) after being refereed according to the publication standard of JJAP. With respect to this quick publication of papers, the great cooperation and hard work of the designated referees should be especially mentioned, and the organizers of FMA-12 are very thankful to them.

The FMA-13 will be held at Coop-Inn Kyoto, Kyoto, from 29 May - 1 June 1996, right after the Third Pacific Rim Conference on the Application of Ferroelectrics, 27 - 29 May 1996, to be held at the same site.

Y. Ishibashi
Program Chairman of FMA-12
Nagoya University

CSC'2 PAPERS

cont.

Polarons in SiO₂

C.K. Ong and X. Zhang

Dielectric Behavior of Disordered Ion Irradiated Iron Oxides

J.M. Costantini

Charge Trapping/De trapping Induced Lattice Polarization/Relaxation Processes

G. Blaise

Description Microscopique de l'Energie Interne d'un Réseau Cubique Polarisé par une Charge Piégée

C. Coudray and G. Blaise

Simulation by Molecular Dynamics of the Trapping of Charges in Alumina

K.H. Oh, C. Rambaud, H. Jaffrezic, and S. Fayeulle

A Molecular Model for the Electrical Aging of Insulating Polymers

J.P. Crine

The Role of Trapped Space Charges in the Electrical Aging of Insulating Materials

L. Dissado, C. Mazzanti, and C.C. Montanari

The Auto-Oscillation Model of Prefracted State of Solids and Stimulated Emission of Radiation

W. Bovenko

Electronic Aging of Dielectrics: Effects of 0-15eV Electrons, Analytical Methods

L. Sanche

Contribution of Theoretical Quantum Chemistry to the Study of Nuclear Electric Hypershieldings

M. Defrances

-- continued on page 10

CSC'2 PAPERS*cont.*

Electron Distribution of Charged Dielectrics

C. Bonnelle

Femtosecond History of an Electron Gap in the Conduction Band of a Wide-Band Gap Oxide

G Petite, P. Daguzan, S. Guizard, and P. Martin

Theoretical Study of Secondary Electron Emission of Insulating Targets by the Monte Carlo Simulation Method

J.P. Ganachaud and A. Mokrani

Simulation des la Charge et de l'Emission Secondaire des Isolants soumis a un Bombardement Electronique: Application au Quartz

E. Vicario

The Behavior of Different SiO₂ Samples (Quartz, Geis, Thin Films) Under Electron Irradiation

P. Durupt, M. Ghamnia, and C. Jardin

Optical Emission due to Space Charge Effects in Polymers: An Insight Into Wearout and Break-down Mechanisms

C. Laurent, C. Mayoux, and F. Massines

Sur le Mouvement des Charges Excédentaires dans les Isolants. Application au Déclin Naturel du Potentiel sur les Echantillons Chargés

R. Coelho and B. Aladenize

The Single Crystal a Wire Formation in Grooves on the Amorphous SiO₂ Surface

T. Ichinokawa, D. Inoue, and T. Watanabe

CONFERENCE REPORTS**ONR WORKSHOP ON FUNDAMENTAL EXPERIMENTS IN FERROELECTRICS**

Each year a workshop on basic studies of ferroelectric materials is held in Williamsburg, Virginia, sponsored by the Office of Naval Research (**Dr. Wallace A. Smith**). Emphasis alternates every year between theory and experiment. This year's workshop, held 5 - 8 February, and organized by **Professor Takeshi Egami** of the University of Pennsylvania, was the third on fundamental experiments. The topics covered include atomic structure, electronic structure, lattice dynamics, phase transition, defects, ferroelectric domains, and basic issues relevant to applications.

Discussions were focused particularly on critical issues, such as the electronic structure as studied experimentally by photoemission and theoretically by LDA calculations, the nature of phase transitions in terms of order/disorder vs displacive transition, and the local structure of perovskites. The proceedings of the meeting will be published in the *Journal of Physics and Chemistry of Solids*.

Next year's workshop on theory will be organized by **Dr. R.E. Cohen** of the Carnegie Institute of Washington, Geophysical Laboratory, and the one on experiment in 1997 by **Professors Haydn Chen** and **Dwight Viehland** of the University of Illinois.

The scientific program was as follows:

1. Special Topics

PZT Revisited: Neutron Scattering Study

G. Shirane (Brookhaven N. L.)

Vibrational Anomalies in Quantum Paraelectrics

E. Cortens (University of Montpellier)

What Does Theory Teach Us About Oxide Ferroelectrics and Ferroelectricity?

R.E. Cohen (Carnegie Institute)

2. Electronic Structure

Electronic Structures and Electron-Phonon Coupling in Insulating and Lightly Doped Oxides: Photoemission Spectroscopy Studies

A. Fujimori (University of Tokyo)

Resonant Photoelectron Spectroscopy Studies of BaTiO₃ and Related Mixed Oxides

S.W. Robey (NIST)

Ferroelectric Phase Transitions From First Principles

K.M. Rabe (Yale University)

Applications of the Self-Consistent Atomic Deformation Model

L. Boyer (NRL, Harvard)

3. Lattice Dynamics

Phonon Renormalization and MIR Absorption in High Temperature Superconductors: New Results and Questions

E. Salje (Cambridge University)

Femtosecond Spectroscopy of Optic Phonons in Ferroelectrics: The Linear Response Regime and Beyond

K.A. Nelson (MIT)

CONFERENCE REPORTS

ONR WILLIAMSBURG WORKSHOP -- continued from page 10

Anharmonicity of the Lowest Frequency $A_1(\text{TO})$ Phonon in PbTiO_3

C. Foster (Argonne N.L.)

The High Temperatures Acoustic Phonon Properties of Ferroelectric Materials Determined by Brillouin Scattering

Z. Li (Argonne N.L.)

4. Application

Review of New Experimental Information on the PZT, PLZT, and PZSnT Transducer Material Composition Systems

L.E. Cross (Penn State University)

Remaining Theoretical Problems in Ceramic Actuators

K. Uchino (Penn State University)

Status Report on Ferroelectric Memories

J.F. Scott (Royal Melbourne Institute of Technology)

5. Phase Transition

Competition Between Order/Disorder and Displacive Behavior at the Paraelectric/Ferroelectric Phase Transition

A. Bussman-Holder (Max-Planck-Institut)

Atomic Resolution Experiments by EXAFS of the Local Structure of Various Ferroelectrics Through the Phase Transition

E.A. Stern (University of Washington)

Probing the Short-Range Order and Dynamics of Phase Transition Using Neutron Powder Diffraction

S.J.L. Billinge (Michigan State University)

6. Lattice Effects

Phonon Dispersion and Anharmonicity in Cubic Potassium Niobate

H. Chen (University of Illinois)

First-Principles of Chain-Structure Instability in KNbO_3

H. Krakauer (William and Mary)

The Two-Step Ferroelectric Transition in $\text{KTa}_{1-x}\text{Nb}_x\text{O}_3$

J. Toulouse (Lehigh University)

An Experimental Study of the Impurity Effects on the Para-to-Ferroelectric Transition in PbTiO_3 and BaTiO_3

N. Takesue (University of Illinois)

7. NMR, Defects

NMR of Proton and Deuteron Motion in H-Bonded Ferroelectrics and Proton Glasses

R. Blinc (University of Ljubljana)

EPR and ENDOR Measurements of Slow Dynamics in Hydrogen-Bonded Ferroelectrics and Proton Glasses

N. Dalal (West Virginia University)

Conductivity Across Random Barrier Distribution as Origin of Large Low-Frequency Dielectric Peak in Perovskite Crystals and Ceramics

H. Schmidt (Montana State University)

8. Ferroelectric Domains, Defects

Domain Configurations due to Multiple Misfit Relaxation Mechanisms

in

Epitaxial Ferroelectric Thin Films

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CSC'2 PAPERS

cont.

Dielectric Surface Properties Under a Polarization Field: Condensation and Growth of Metal Films

E. Gillet and M. Gillet

Caractérisation par les Méthodes Calorimétriques de l'Effet d'une Charge d'Espace dans les Diélectriques Solides

D. Moya-Siesse, A. Sami, and G. Moya

Space Charge Characterization. The State of Art and Further Needs

C. le Gressus

Sample Preparation for Space Charge Characterization

J.D. Geller

Space Charge Characterization by Photoelectron Spectroscopy

Method: Determination of Thin Dielectric Properties on Semiconductor Wafer by SCS Measurements

A. Ermolieff, V. Charrassini, S. Marthon, J. Piaguet, D. Rathbone, and S. Deleonibus

Space Charge Influence Generated by Electronic Beam on Insulator Secondary Emission

P. le Berre

Space Charge Characterization of Semiinsulators by the Thermal Pulse Method

A.D. DeReggi

Space Charge Characterization by Coupling the Thermal Step Method and Thermostimulated Currents

A. Tourelle

Electronic Trap Microscopy in Insulating Layers

H. J. Fitting

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CSC'2 PAPERS*cont.*

Mesure des Etats d'Interface
Semiconducteur/Oxyde

J. Qualid and J.M. Moragues

Kerr Electrooptic Field and Space
Charge Measurements Using Point-
Plane Electrode

M. Zahn and R. Hanaoka

Force Measurements on Dielectrics:
Preliminary Results

*P. Carles, N. Poutigny, F.
Guerrini, J.-P. Béghé, and A.
Berthault*

CDA Instrument for Materials
Research and Catalyst Characteriza-
tion

*J.J. Plombon, F. Freund, and
M.M. Freund*

Performance Limitations in High
Voltage Devices in the LEP Elec-
tron Positron Collider and Its SPS
Injector

*N. Garrel, B. Goddard, W.
Kalbreier, and R. Keizer*

Production of Intense Electron
Beams With Ferroelectric Materials

H. Riege

Processing Induced Degradation in
Si/SiO₂ Systems

*R.A.B. Devine, D. Mathiot, W.L.
Warren, P. Paillet, and J.L.
Leray*

Relaxation of the Space Charge
Created by Fowler-Nordheim
Injections in Gate Oxide of MOS
Capacitors

*J. Qualid, J.M. Moragues, B.
Sagnes, and R. Jerisian*

Effects of Structural Parameters of
Polyethylene on Space Charge
Properties

*D. Marsacq, P. Hourquebie, L.
Olmedo, and H. Janah*

CONFERENCE REPORTS

ONR WILLIAMSBURG WORKSHOP -- continued from page 11

J.S. Speck (UCSB)

Theoretical and Transmission Electron Microscope Studies and Domain
Structures in Ferroelectrics

W. Cao (Penn State University)

Defects and Charge Transport in Perovskite Ferroelectrics

D.M. Smyth (Lehigh University)

9. Local Structure

Spectroscopic Characterization of Point Defects in Ferroelectric Materi-
als

D.J. Keeble (Michigan Technical University)

Structure and Dynamics of Relaxor Ferroelectrics

S. Vakhrushev (Ioffe Institute)

Local Atomic Structure of Complex Ferroelectric Perovskites: An
EXAFS Study

I.-W. Chen (University of Michigan)

10. Relaxor Ferroelectrics

Local Atomic Structure of PZT and PLZT Studied by Pulsed Neutron
Scattering

S. Teslic (University of Pennsylvania)

A New Perspective of High Zr-Content Lead Zirconate Titanate

D. Viehland (University of Illinois)

On Locally Heterogeneous (Colloidal) State in Ferroelectric Solutions

A. Khachatryan (Rutgers University)

Takeshi Egami

Department of Materials Science and Engineering

University of Pennsylvania

Philadelphia, PA 19104-6272

Influence of Surface Charge on the
Stochastic Behavior of Partial
Discharge in Dielectrics

*R.J. van Brunt, P. von Glahn,
and T. Las*

Correlation Between High Tension
Insulator Performances in Vacuum
and Space Charge Characteristics

*P. Klein, J. Roue, and J.C.
Pauwels*

Quality of High Voltage Cable
Insulators Evaluated for Their
Ability to Trap and Relax Charges

*H. Janah, P. Mirebeau, and B.
Aladenize*

Détermination du Champ Electrique
de Claquage des Céramique de
Fenêtres RF

A.J. Durand

The Need for Standards: Technical
Terms, Materials, Characterization
and Test Procedures

C. le Gressus

Study of the Space Charge Effects
in Silicon Dioxide Single Crystals,
Influence of the Electrodes

*N. Farhat, C. Alquie, and J.
Lewiner*

Investigation of Negative Charges at
the Interface of Bonded Silicon on
Insulator Wafers

P.T. Bailey, G. Jin, B.M.

Armstrong, and H.S. Gamble

Influence d'Irradiations X et UV sur
les Propriétés Mécaniques et sur les
Propriétés de Charge sous

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CSC'2 PAPERS

Bombardement Electronique du Saphir
J. Bigarre, N. Boukheit, and D. Treheux

Effet de la Temperature sur le Piégeage et Dépiégeage de Charge
J. Bigarre, C. Rambaut, and S. Fayeulle

Roles des Dopants sur la Capacité de Piégeage et sur les Propriétés Mécaniques de l'Alumine
J. Bigarre, N. Boukheit, and S. Fayeulle

The Apparent Capacitance and the Total Harmonic Distortion as Evidence of Mobile Ions in an Organic Binder
M. Biron and R. Goffaux

Caractérisation de Composants Haute Tension par Décharges Partielles
R. Boucheteau, H. Biero, and C. Prisset

The Electric Images Theory Applied to Space Charge at Dielectric Interfaces
J. Cazaux

Low-Energy Electron Experiments With Industrial Polyethylene Samples
P. Cloutier and L. Sanche

Conduction Induite sous Rayonnement Moyen Experimental CIRCE
M. Fichet

Slow Polarization of Delocalized Positive Holes in a Static Electric Field and the Fowler-Nordheim Mechanism of Dielectric Failure

F. Freund, M.M. Freund, S.J. Butow, P. Sarrazin, and J.C. Niepce

Space Charged Limited Conduction in Amorphous Semiconductor-Polystyrene-Semiconductor (SPS) Sandwich Material
W.J. Gawande, S.V. Pakade, S.P. Yawale, S.G. Motke, and D.K. Burghate

Space Charge Characterization or Ion-Irradiated Polyimide Films by the Pressure Pulse Method
M.P. Cals, J.M. Costantini, F. Isaac, and J.P. Marque

Simultaneous Measurements of the Surface Potential and Cathodoluminescence of Al₂O₃ Samples
C. Jardin, P. Durupt, C. Riviere, M. Robin, and C. le Gressus

Electron Emission From Ferroelectric Crystals and Ceramics
R. le Bihan, S.F. Liatani, and D. Averty

Flashover Triggered by Charge Detrapping at Dielectric Vacuum Interface
C. le Gressus

Study of an Oxygen Vacancy in MgO Clusters.
M.J. Malliavin, C. Coudray, and G. Blaise

Influence de l'Usinage sur les Propriétés de Charge de Monocristaux MgO et α Al₂O₃
B. Vallayer and D. Treheux

Influence d'une Irradiation X sur le Comportement en Frottement des Matériaux Diélectriques

J. Vallayer, S. Fayeulle, M. Belin, and P. Parent

Application of the Mirror Method to the Breakdown Characterization of Klystron Windows
B. Vallayer, Y. Saito, and D. Treheux

Variation of the α SiO₂ Single Crystal Complex Permittivity as a Function of the Trapped Charge Density
A. Bel Hadj Mohamed, K. Raouadi, and C. Cheffi

Space Charge Measurements by Thermal Step Method in Single Crystal Al₂O₃
S. Agnel and A. Toureille

Polarizability and Electronic Affinity Impurity Effects on Alumina Macroscopic Properties
E. Moya-Gontier, F. Moya, A. Sami, and N. Boukheit

Modelization of Both Electronic Trajectories and Electric Field Distribution in the Vacuum Near a Trapped Charge Implanted With an Electron Beam
B. Vallayer

Charge Storage in the Multilayer Silicon Nitride Films of MNOS Structures
A.A. Evtukh, V.G. Litovchenko, and V.G. Popov

Dielectric Relaxation Processes in the High Disperse SiO₂-H₂O and TiO₂SiO₂-H₂O Systems
V.I. Zarko and V.M. Gun'ko

Thermostimulated Charge Buildup in MDM Devices
L. Kormilizin

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UPCOMING MEETINGS

8th International Symposium on Integrated Ferroelectrics (ISIF 96) 17 - 20 March 1996 Tempe, Arizona

Call for papers

Authors are invited to submit a 300-word abstract by **1 November 1995**. Topics at the ISIF 96 include, but are not limited to:

- ferroelectric memories
- ferroelectrics and pyroelectric CCDs
- high dielectric constant materials for ULSI DRAMs
- integrated optics
- optical storage
- radiation related subjects, such as radiation hardness
- fundamental properties
- process and substrates
- process integration
- new devices and architecture
- device modeling
- materials processing and integration
- supporting circuitry and applications
- ferroelectric ASICs
- smart tags and RF ID devices
- neural networks
- microsensors and actuators
- bypass capacitors
- GaAs/ferroelectric devices
- reliability
- applications and new products
- biomedical

Tutorial session

Three tutorial sessions, which will run consecutively, are planned for Sunday, 17 March 1996, from 1:00 to 6:00 p.m. Tentative topics for the three sessions are: fundamentals of integrated circuit processing, fundamentals of ferroelectric materials, and testing methodologies. **Dr. R. Ramesh**, organizer of the tutorials, would like to know the extent of interest for these sessions. For further information please contact Dr. Ramesh at the University of Maryland, College Park, MD 20742, phone (301) 405-7364, fax (301) 314-9467.

Organizers

C.A. Paz de Araujo and **R. Panholzer**, chairmen; **S.K. Dey**, technical program chairman; **B.M. Melnick**, on-site chairman; **R. Ramesh**, tutorial chairman.

Contact

Alona S. Miller, Symposium Coordinator, University of Colorado at Colorado Springs, PO Box 7150, Colorado Springs, CO 80933-7150, phone (719) 593-3488, fax (719) 594-4257

SCS'2 PAPERS

cont.

Application de la Technique des
Positons aux Diélectrique Chargés
*X.H. Li, A. Sami, P. Stocker, G.
Moya, and P. Moser*

Prospects of Making Static Electric-
ity Sensors on Anodic Alumina
Substrates
N. Mukhurov

Influence of Charged Surface on the
Dielectric Gap. Exact Solvable
Model
E.Y. Glushkov

The next issue (Fall 1995) of the *Ferroelectricity Newsletter* will be available on World Wide Web

This is the last issue which will be mailed to everybody on the mailing list. If you want to receive a hard copy of the newsletter by mail **after this issue**, please let us know.

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Mail **Hannah Liebmann, 500 Glenwood Circle, Suite 238
Monterey, CA 93940-4724, USA**

UPCOMING MEETINGS

1996 MRS Spring Meeting 8 - 12 April 1996 San Francisco, California

The 1996 Spring Meeting will feature 28 symposia covering a broad range of materials science and engineering as well as processing topics. It provides symposia that cross research boundaries, continuing the MRS tradition of establishing a forum for the exchange of information across disciplines that are at the leading edge of materials research.

Traditional MRS symposia offered include nitrides and other wide bandgap semiconductors; amorphous silicon and display materials; ceramics; superconductor; rapid thermal processing; photovoltaics.

Several symposia will focus on emerging areas of materials research, including microporous and mesoporous materials, novel polymer architectures, innovation in instrumentation, geochemistry of oxides, and hybrid organic and inorganic materials. An array of tutorials will complement the technical program. A major exhibit will also be offered.

Abstracts of contributed papers must be received at MRS headquarters no later than **1 November 1995**.

Contact

Materials Research Society, Meetings Department, 9800 McKnight Road, Pittsburgh, PA 15237
phone (412) 367-3003, fax (412) 367-4373, e-mail info@mrs.org

Bibliography of Ferroelectrics

A listing of articles, books, and conference proceedings dealing with ferroelectrics and related materials published throughout the world and covering mainly the period January to June 1991, can be found in *Ferroelectrics* Volume 166 Numbers 1-4 (1995), pp. 235-302.

Koichi Toyoda of the Center for Joint Research, Shizuoka University, Hamamatsu 432, Japan, is the author of the bibliography.

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CALENDAR OF EVENTS 1995	
Aug 26-29	<ul style="list-style-type: none"> 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, Kudanshita Building, 1-12-3 Kudan-kita, Chiyoda-ku, Tokyo 102, phone +81 33 238 1044, fax +81 33-221 6245
Sep 11-16	<ul style="list-style-type: none"> Organized Molecular Films, Ancona, Italy. For information contact M.G. Ponzi Bossi (LB7), Istituto di Scienze Fisiche, Universita degli studi di Ancona, Via Ranieri 65, 60131 Ancona, Italy phone +39-71 2204-606 or +39-71 2204-605
Sep 21	<ul style="list-style-type: none"> Morphology, Surface Interactions, and Control of Crystal Growth, London, England. For information contact Dr. Simon Redfern, Department of Earth Science, University of Cambridge, Cambridge CB2 3EQ, England, phone +44-223 333-475, fax +44-223 333-450, e-mail satr@esc.cam.ac.uk
Oct 5-8	<ul style="list-style-type: none"> First Asian Meeting on Ferroelectrics (AMF-1), Xi'an, China (see <i>Ferroelectr. Newsl.</i> Vol. 3, No. 2, p. 11)
Oct 23-27	<ul style="list-style-type: none"> Pre-Equilibrium Reactions, Smolenice Castle, Slovakia. For information contact E. Betak, Institute of Physics, Slovak Academy of Sciences, 84228 Bratislava, Slovakia
Nov 27- Dec 1	<ul style="list-style-type: none"> 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	
Mar 17-20	<ul style="list-style-type: none"> 8th International Symposium on Integrated Ferroelectrics (ISIF 96), Tempe, Arizona (see p. 14)
Apr 8-12	<ul style="list-style-type: none"> 1996 MRS Spring Meeting, San Francisco, California (see p. 15)
May 27-29	<ul style="list-style-type: none"> Third Pacific Rim Conference on Applications of Ferroelectrics, Coop-Inn Kyoto, Japan
May 29- Jun 1	<ul style="list-style-type: none"> 13th Meeting on Ferroelectric Materials and Their Applications (FMA-13), Coop-Inn Kyoto, Japan
Aug 18-21	<ul style="list-style-type: none"> 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