

**International Workshop
on SiP/SoC Integration of MEMS
and Passive Components with RF-ICs**

Tuesday, 2nd, March, 2004

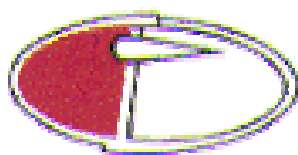
**Second International Symposium
on Acoustic Wave Devices
for Future Mobile Communication Systems**

Wednesday, 3rd - Friday, 5th March, 2004

Keyaki Hall, Chiba University

Sponsored by

**Japanese Ministry of Education, Culture,
Sports, Science and Technology
and Chiba University**



千葉大学

Welcome to Chiba!

On behalf of Chiba University and the Organising Committee, I am most delighted to invite you to the Second International Symposium on Acoustic Wave Devices for Future Mobile Communication Systems, and International Workshop on SiP/SoC Integration of MEMS and Passive Components with RF-ICs.

The First Symposium, held right at the start of the 21st century, was an international meeting focussed upon the most important fields related to acoustic wave devices. Many researchers and engineers gathered at Chiba University from all over the world and discussed in detail how to respond to the rapidly changing needs of emerging communication technologies. This Symposium was a great success, with a total of 210 participants including 51 from overseas.

Now, over just the last three years, we have seen many novel developments in acoustic wave device technologies, as well as expanding users' demands for high bit rates and large capacities in mobile communications. For example, new devices like FBARs and SMRs have already become competitive with conventional SAW and BAW devices, while IF filters have disappeared in some mobile phones. FBAR and SMR devices based on Si substrates are now expected to play a key role in realising SoC/SiP modules.

Therefore, the Organising Committee and Chiba University have again decided to offer researchers and engineers a platform to discuss future trends as well as state-of-the-art technologies related to acoustic wave device technologies and related field. The programme has been organised to cover a wide range of topics from materials to systems, with emphasis on (1) current status of, and future trends in, research and development related to acoustic wave devices, and (2) technical breakthroughs required for future mobile communication systems. I very much hope that you will be able to join us in helping to make this a most successful and fruitful opportunity for researchers and engineers working in these fields worldwide.

In conjunction with the Symposium, the workshop is newly organised to offer an opportunity to those involved in MEMS, passive-components and RF-ICs to discuss their ideas freely on future SiP/SoC integration of these devices. We hope the workshop will be a hot appetiser of the Symposium.

Finally, the organising committee is most indebted to the Japanese Ministry of Education, Culture, Sports, Science and Technology and the Chiba University for its sponsorship, and to NTT DoCoMo, Inc., Chiba Convention Bureau, Advantest Corp., Advanced Modular Sputtering Inc. with Matsubo Corp. and Unaxis Japan Co. Ltd. for their financial support.



2nd March, 2004

*Masatsune Yamaguchi
Chairman of the Organising Committee
Professor of EEE
Chiba University*

Tuesday, 2nd March

A. Opening Remarks

9:50 M.Yamaguchi, K.Hashimoto, Chiba University

B. Impact of Passive Components in RF-ICs (Chair: K.Hashimoto, Chiba Univ.)

10:10 Impact of RF-Integration

H.Yoshida, Toshiba Corporate R&D Center

10:40 Potential and Limitation of RF CMOS Technology and Expectation for New Passive Devices

A.Matsuzawa, Tokyo Institute of Technology

11:10 Impact of Passive Devices in RF Oscillators

D.Ham, Harvard University

C. Integration of Acoustic Wave Devices (Chair: T.Omori, Chiba Univ.)

12:50 Integration of SAW and BAW Technologies for Oscillator Applications

C.S.Lam, TXC Corp.

13:20 Integration Aspects of FBAR

R.Aigner, Infineon Technologies AG

13:50 Integration of SAW (BAW) Devices

C.Ruppel, P.Hagn, P.Heide and S.Seitz, EPCOS AG

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D. RF-MEMS and Micro-Assembly (Chair: P.Z.Chang, National Taiwan Univ.)

14:40 A Capacitive RF MEMS Shunt Switch

S.Kobayashi, H.Kawai, Murata MFG, Co. Ltd.

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15:10 Stability Issues in MEMS Devices and Packages

H.Toshiyoshi, University of Tokyo

15:40 Fujitsu's Highly Integrated Assembly Technology for SiP

M.Natsuaki, Fujitsu Ltd.

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E. Panel Discussion (Moderator: R. Weigel, Univ. Erlangen-Nuremberg)

16:30

Wednesday, 3rd March

Opening Remarks

9:30

M.Yamaguchi, Chiba University

1A Key Note Speech (Chair: M.Yamaguchi)

9:40 **Current SAW Research Activities in Japan** 1
K.Yamanouchi, Tohoku Institute of Technology

1B Mobile Communication and Sensor Applications (Chair: D. Ham)

10:30 **Ubiquitous Network** 9

S.Kameda, S-K.Kim, H.Nakase and K.Tsubouchi, Tohoku University

11:00 **Design of Global SAW RFID TAG Devices** 15

C.S.Hartmann, P.Brown and J.Bellamy, RF SAW, Inc.

11:30 **Wireless Passive SAW Identification Marks and Sensors** 21

L.M.Reindl, Albert-Ludwigs University, Freiburg

12:00 **Readout Unit for Wireless SAW Sensors and ID-Tags** 37

A.Stelzer, S.Schuster and S.Scheibhofer, University of Linz

1C Role of SAW and BAW Devices in RF Circuits and Oscillators (Chair: K. Bhattajaree)

13:30 **On the Role of SAW Devices in Current and Future Radio Systems** 45

R.Weigel^{1,2}, M.Schmidt¹, D.Pimingsdorfer² and L.Maurer²

1) University of Erlangen-Nuremberg, 2) DICE Danube Integrated Circuit Engineering

14:00 **Analysis of Crystal Oscillator** 51

T. Adachi, Yokohama National University

14:30 **Phase Noise in Oscillators** 57

D.Ham, Harvard University

15:00 **Simulation and Design of RF Oscillators** 69

L.Eichinger¹, F.Sischka¹, G.Olbrich² and R.Weigel³, 1) Agilent Technologies,

2) Munich University of Technology, 3) University of Erlangen-Nuremberg

1D SAW and BAW Materials (Chair: C. Lambert)

16:00 **KNbO₃ Single Crystals and Thin Films for SAW and BAW Devices** 77

K.Nakamura and S.Ito, Tohoku University

16:30 **Homogeneity Evaluation of SAW Device Wafers by the LFB Ultrasonic** 83

Material Characterization System

J.Kushibiki and Y.Ohashi, Tohoku University

17:00 **High Frequency SAW Resonators by SiO₂/ZnO/Diamond and Its Application to** 91

2.5GHz Low Phase Noise VCISO

S.Shikata¹, H.Nakahata¹, S.Fujii¹, T.Uemura¹, Y.Takada², T.Kano²,

N.Itoh² and O.Iwamoto², 1) Sumitomo Electric. Ind. Ltd., 2) Seiko Epson Corp.

17:30 **Welcome Reception**

Thursday, 4th March

2A BAW Devices (Chair: L. Reindl)

9:00 Development of Miniaturized Analog and Digital Temperature Compensated Crystal Oscillators 95

C.S.Lam and C.W.Chiang, TXC Corp.

9:30 Real-Time Visualization of Mode Shapes in Piezoelectric Resonators 99

Y.Watanabe, H.Kitabori, S.Goka, T.Sato and H.Sekimoto, Tokyo Metropolitan University

10:00 UHF Fundamental Quartz Resonators 107

H.Iwata, Toyo Communication Equipment, Co. Ltd.

2B RF-MEMS and FBAR Integration (Chair: W. Menzel)

11:00 RF MEMS and MEMS Packaging 115

M.Hara and M.Esashi, Tohoku University

11:30 Mechanical Behavior of RF MEMS 123

H.H.Lin, C.H.Chu, C.L.Chang and P.Z.Chang, National Taiwan University

12:00 Volume Manufacturing of BAW-Filters in a CMOS Fab 129

R.Aigner, Infineon Technologies AG

2C Recent FBAR Technologies (Chair: R. Aigner)

13:30 FBAR – From Technology Development to Production -- 135

R.C.Ruby, Agilent Technologies, Inc.

14:00 Development of 5GHz FBAR Filters for Wireless Systems 141

Y.Satoh, T.Nishihara, T.Yokoyama, M.Iwaki and T.Miyashita, Fujitsu Laboratories, Ltd.

14:30 Simulation of Second-Order Effects in SBAR and FBAR 145

R.F.Milsom, H-P.Löbl, and C.Metzmacher, Philips Research Laboratories

2D Piezoelectric Thin Films for FBAR, (Chair: R. Ruby)

15:30 Growth of Bulk AlN Crystals for SAW Devices 157

B.M.Epelbaum, M.Bickerman and A.Winnacker, University of Erlangen-Nuremberg

16:00 Zinc Oxide Piezoelectric Thin Films for Bulk Acoustic Wave Resonators 163

Y.Yoshino, Y.Ushimi, H.Yamada and M.Takeuchi, Murata MFG, Co. Ltd.

16:30 BAW Devices: Technology Overview and Manufacturing Aspects 171

C.Lambert¹, D.Borrello¹, H.Choffat¹, P.Jacot¹ and E.Kuegler²

1) Unaxis SPTec SA, 2) Unaxis Balzers AG

17:00 Social Gathering

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3A SAW Device Simulation (Chair: R. Milsom)

- 9:00 Application of Cu Electrodes to SAW IF Filters** 179
T.Omori, K.Hashimoto and M.Yamaguchi, Chiba University
- 9:30 FEM/BEM Analysis for SAW Devices** 185
M.Solal¹⁾, T.Abboud²⁾, S.Ballandras³⁾, S.Chamaly¹⁾, V.Laude³⁾,
R.Lardat¹⁾, T.Pastureaud¹⁾, J.Ribbe²⁾, W.Steichen¹⁾ and P.Ventura¹⁾,
1) Temex, 2) CMAP Ecole Polytechnique, 3) CNRS/LPMO
- 10:00 RF and SAW Package Simulation** 203
W.Menzel¹⁾, H.Bilzer¹⁾, P.Schuh¹⁾ and M.Pitschi²⁾, 1) University of Ulm, 2) EPCOS AG

3B New Materials and Processes for SAW Devices (Chair: M. Solal)

- 11:00 Miniaturization of IF SAW Filters** 211
M.Kadota, Murata MFG Co. Ltd.
- 11:30 Analysis of Highly Piezoelectric SAWs by Procedures Combining Finite-Element and Analytical Method, and Their Applications to Mobile Communication Devices** 221
A.Isobe, M.Hikita and K.Asai, Central Research Lab., Hitachi, Ltd.
- 12:00 Ultra Wideband Love Wave Devices in GHz Range on Cu-Grating/Rotated-YX-LiNbO₃-Substrate Structure** 229
H.Asano, K.Matsuda, N.Yokoyama, K.Hashimoto,
T.Omori and MYamaguchi, Chiba University

3C RF SAW Filters (Chair: C. Ruppel)

- 13:30 Advances in RF SAW Substrates** 235
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N.Naumenko and P.Welsh, SAWTEK, Inc.
- 14:00 RF SAW Filters and Duplexers Using Plastic Package Technologies** 247
S.Yoshimoto, T.Onzuka and Y.Yamamoto, NRS Technologies, Inc.
- 14:30 Design Concept of Wideband Longitudinally-Coupled Double-Mode SAW Filters** 253
K.Hashimoto, T.Omori and M.Yamaguchi, Chiba University

3D SAW Duplexers and Modules (Chair: B. Abbott)

- 15:30 High Performance SAW Antenna Duplexer using Ultra-Low-Loss Ladder filter and DMS for 1.9GHz US PCS(4)** 263
M.Ueda¹⁾, J.Tsutsumi¹⁾, S.Inoue¹⁾, Y.Iwamoto¹⁾, M.Miura¹⁾, T.Matsuda¹⁾, O.Ikata²⁾
and Y.Satoh¹⁾, 1) Fujitsu Laboratories, Ltd., 2) Fujitsu Media Devices, Ltd.
- 16:00 SAW Front End Module Concept for Multi Band GSM System** 267
M.Moteki¹⁾, T.Shiba¹⁾, K.Sakiyama¹⁾, N.Kamogawa¹⁾ and M.Hikita²⁾,
1) Hitachi Media Electronics, Co. Ltd., 2) Central Research Lab., Hitachi Ltd.
- 16:30 Integrated Multi Band/Mode Frontend Modules for Next Generation Mobile phones** 271
P.Hagn, A.Przadka, V.Gebhardt, L.Höfner and C.Ruppel, Epcos AG
- 17:00 Advanced SAW Packaging for Modular Integration** 279
M.Goetz, C.Jones, J.Rao, K.Bhattacharjee and J.Flowers, Clarisay, Inc.

Closing Address

- 17:30** K.Hashimoto, Chiba University