

**9th EUROPEAN SYMPOSIUM ON
RELIABILITY OF ELECTRON DEVICES
FAILURE PHYSICS AND ANALYSIS**

**ESREF 98
Copenhagen, Denmark
5 - 9 October 1998**

Organized by
FJRC - Finn Jensen Reliability Consultancy

In collaboration with
IAE - Department of Applied Electronics
The Technical University of Denmark

In conjunction with
EOBT - Electron and Optical Beam Testing Conference



IEEE

Electron Devices Society

Invitation to ESREF 98

The European Symposium on Reliability of Electron Devices, Failure Physics and Analysis, ESREF, is the annual forum for reliability physics and analysis of electronic components in Europe.

The Copenhagen event is the 9th conference in the series. In 1991 ESREF merged with the International Conference on Quality in Electronic Components, Failure Prevention, Detection and Analysis. It now merges with the European EOBT Conference on Electrical and Optical Beam Testing. The ESREF conferences are seen to target a very broad cross section of research in the fields of electronic component reliability and failure analysis, and each year an increasing numbers of papers and participants from all over the world contribute to making this a truly international event.

Whilst the major emphasis is on silicon integrated circuits, there are sessions devoted to also compound semiconductor reliability and optoelectronic devices, to packaging techniques, and, for the first time a session is given to a new major growth area, MEMS, or microelectromechanical systems.

This year more than 70 papers will be presented at the conference. Additionally each of the eight themes will be introduced by an invited paper presented by an internationally recognised expert. The technical programme will also include four tutorials on the morning of Tuesday 6th, prior to the opening of the conference. These tutorials provide attendees with a unique opportunity to survey the state-of-the-art on selected topics.

Following the tradition of recent ESREF conferences three workshops will take place on Monday 5th. The workshops are organized separately from the main conference, but are coordinated with the ESREF themes. This year the workshops comprise COTS (Components-off-the-shelf), FIB (Focused Ion Beam Techniques) and Power Devices.

Finally, an extensive exhibition of equipment manufacturers, service providers and publishers, related to component reliability and failure analysis, will as usual lend added value to the conference week.

This is the first time an ESREF Conference is held in a European capital city. We hope that many attendees will be tempted to prolong their stay over a weekend in order to enjoy the many attractions of our historic city.

Welcome to ESREF and to Copenhagen!

Finn Jensen
Conference Chairman

Claus Kjærgaard
Technical Programme Chairman

We wish to thank the following for their contribution to the success of this conference:

United States Air Force European Office of Aerospace Research
and Development.

TeleDanmark

Ericsson Telecom AB

The Technical University of Denmark

We are happy also to acknowledge the technical co-sponsorship of:

IEEE Electron Devices Society, USA

VDE/ITG - Germany

SRE - Scandinavian Reliability Engineers



IEEE

Electron Devices Society

GENERAL INFORMATION

Conference location

The Conference will be held at the Scandic Hotel Copenhagen near the city centre. All conference activities will be at ground level. This includes the lectures, tutorials, exhibition, workshops and the conference offices. The address is

SCANDIC HOTEL COPENHAGEN

Vester Søgade 6

DK-1601 Copenhagen V.

Tel.: (+45) 33 14 35 35

Fax: (+45) 33 32 12 23

The hotel is just a short walk from the central railway station and about twenty minutes by car from Copenhagen Airport.

Conference office

The Conference office is with Van Hauen Conferences and Incentives, Amaliegade 36, DK-1256 Copenhagen K.

Tel: (+45) 3314 0050,

Fax: (+45) 3314 5750

e-mail: um@vanhauen.dk

During the conference the office and registration desk will be open at the Scandic Hotel with the following opening times:

Monday	October 5	8:00 - 10:00 and 18:00 - 20:00
Tuesday	October 6	8:00 - 18:00
Wednesday	October 7	8:00 - 18:00
Thursday	October 8	8:00 - 18:00
Friday	October 9	8:00 - 12:00

During the conference you may receive messages at the conference office on

Tel: (+45) 33 36 06 28

Fax: (+45) 33 14 57 50.

Registration

All conference participants including the authors, invited speakers, and tutorial presenters are requested to fill in and return the attached registration form as soon as possible. Registration forms should be **sent** no later than August 21st to the conference office.

A separate registration is required for the workshops.

Conference banquet

The conference dinner is on Thursday, October 8. This will be held in the restaurant of the nearby theatre, Det ny Teater, at 19:00. Extra banqueting tickets may be booked through the Van Hauen office.

Conference fees

The conference fee includes

- admission to the scientific sessions
- admission to the tutorials and to the equipment exhibition
- a copy of the proceedings
- coffee/tea during breaks
- lunches on Tuesday, Wednesday and Thursday
- conference banquet

Conference and workshop fees are as shown below. Fees are in Danish Kroner, DKK.

	Early registration Before August 21st	Late registration After August 21st
Attendees, speakers, committee members	4.950 DKK	5.500 DKK
University and student attendees.	3.700 DKK	4.000 DKK
Workshop registration:		
COTS workshop	1020 DKK	1200 DKK
Power Devices workshop	Free	Free
FIB workshop	Free	Free

Payment

Payment should be made in Danish Kroner by credit card or bank transfer. See the registration form for details.

Upon receipt of the registration form, Van Hauen Conferences will book a hotel room if requested (1st or 2nd priority) and mail an invoice to you with instructions for payment. If you wish to pay by credit card please give card information on the form.

Cancellation:

Written request for cancellation of registration received before August 21st 1998 will result in refund of paid fees with exception of an administrative fee of DKK 400,00. After that date, no refunds can be made.

Written cancellation of hotel reservation to Van Hauen Conferences before September 7th will result in refund of paid fees except for a cancellation fee of DKK 150,00. After that date a cancellation fee corresponding to the first night of accommodation will be charged.

Hotel accommodation

A block of rooms has been reserved at the Scandic Hotel Copenhagen. To reserve a room here or at one of the hotels on the attached registration form please check and return the form as soon as possible. Copenhagen is a popular conference city and rooms can be difficult to obtain at short notice.

For those interested in very low cost accomodation, please contact the youth hostels in Copenhagen:

Copenhagen Danhostel Bellahøj
Herbergsvejen 8
DK-2700 Brønshøj
Denmark
Phone: (+45) 3828 9715
Fax: (+45) 3889 0210

Copenhagen Danhostel Amager
Vejlands Allé 200
DK-2300 Copenhagen S
Denmark
Phone: (+45) 3252 2908
Fax: (+45) 3252 2708

Conference language

The conference language is English.

The proceedings

The ESREF 98 proceedings will be published by Elsevier Sciences Ltd as a special issue of their journal Microelectronics Reliability. The proceedings is included in the conference fee

Best Paper Awards

The ESREF conferences confer two best paper awards, one each in the categories:

- a) regular contributed paper
- b) student paper

The winners will be announced at the closing session of ESREF 98 on the Friday.

An exchange agreement with the IRPS (USA) and the Japanese Reliability Symposium on Electronic Devices will allow the winners to present their papers at one of these conferences the following year.

Additional information

You may at any time find information on the ESREF 98 web site

<http://www.iae.dtu.dk/esref98>

which will be updated regularly right up to the conference week.

EXHIBITION

It has become a tradition at ESREF that there will be an exhibition of manufacturers and service providers in the field of reliability and failure analysis.

The following exhibitors have already registered:

AETRIUM Inc.

CARL ZEISS JENA GmbH

DELTA

DESTIN N. V.

ELSEVIER

HAMAMATSU PHOTONICS

HTT High Tech Trade GmbH

John Wiley & Sons

MASER Engineering B.V.

MICROTRON ADVANCED TECHNOLOGY

SERMA TECHNOLOGIES

SIMAC MASIC

SONOSCAN

SYNATRON GmbH

QUALITAU Ltd.

QUANTUM FOCUS INSTRUMENTS Corp

WORKSHOPS AND USER GROUP MEETINGS

Monday, 5 October, 1998

W1 Commercial Parts (COTS) Management PARTS SELECTION AND ASSESSMENT PROCESSES FOR SEVERE ENVIRONMENT AND HIGH RELIABILITY APPLICATIONS

Time: 09:30 - 18:00

Fee: DKK: 1020 (approximately FF 900)

Workshop organizer: M. Barré, MATRA Defense, France

The present Workshop is a follow on initiative to the ESREF/SUCCESS Workshop held in Arcachon in 1997. This year this event is part of the ESREF Program, considered as a User Forum to present and debate of the industrial practices related to Commercial Components Selection and Performance - Reliability Management for Applications working under severe operational conditions.

A whole day has been allocated to the Workshop, in order to cover technical and management issues related to either performance & requirement specification, integrity assessment based upon available manufacturer data, dedicated engineering regarding performance assessment and uprating, dedicated engineering regarding reliability assessment based on physics of failure, integration of POF experience in system level reliability prediction process, or more generally the redesign of manufacturer assessment - certification aims and process to support and give inputs to associated concerns.

Sessions and topics retained as a basis for this workshop are presented on the next page. Sponsors are identified for each session, they are those in charge to organize presentations and discussions for each topic.

The detailed agenda and speakers will be available on the ESREF WEB Site in the September time scale.

The organizers

SUCCESS Consortium:

Selection and Utilisation of Commercial Components for Electronics working under Severe Stress conditions

SUCCESS is a programme implemented in cooperation between Aerospatiale, Alcatel-Espace, Dassault Electronique, GIAT Industries, Matra Bae Dynamics, Matra Marconi Space, Schlumberger, Sfim Industries, Snecma-Elecma, Valeo electronique. Associated partners are IXL - University Bordeaux I, INPG & ENST.

CALCE-EPSC Consortium:

Directed by the University of Maryland -USA CALCE EPSC addresses Part Selection and Management topics and drives a programme supported by more than 40 companies worldwide.

PURE Consortium:

Plastic Used in Rugged Environment.

PURE aims to qualify Commercial plastic back end assembly lines according to PCP qualification reference.

This association is structured around Thomson CSF in France and Ericsson Microwave in Sweden

General Information

The Workshop will be held in conjunction with the 9th European Symposium on Reliability of Electron Devices, Failure physics and analysis, ESREF 98.

Time: Monday, October 5, 1998. 09.30 - 18.00

Location: Scandic Hotel Copenhagen
Copenhagen - Denmark

Registration &

Local arrangements: Conference organization & secretariat.
Van Hauen Conferences & Incentives.
Tel: (+45) - 33 14 00 50
Fax: (+45) - 33 14 57 50

Fees: 1020 DKK (approximately 900 FF)

Administrative support: ADERA Services, BP196, Pessac - France

Tel: (+33) - 556 15 11 58

Fax: (+33) - 556 15 11 60

Technical contacts

SUCCESS

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CALCE

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CALCE - University of Maryland - USA

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PURE

Gilles Deleuze Thomson CSF

Email: gilles.deleuze@ttm.thomson.fr

Ulf Lindgren Ericsson Microwave

Email: Ulf.Lingren@emw.ericsson.se

ESREF

WEB Site:

<http://www.iae.dtu.dk/esref98>

Programme

Session 1 Performance Specification Related to Severe Environment Applications

- Environmental & operational stress / template / requirements / issues
- > Operational stress template update of SUCCESS partner's applications
"Sponsors" Snecma-Elecma, Aerospatiale & SUCCESS
- > Electronic part conformance to environmental requirements
"Sponsors" Smiths Industries & CALCE Consortium
- > Issues regarding parts behaviour operating under Extreme Thermal conditions
"Sponsors" PHILIPS Semiconductors & SUCCESS

Session 2 Market Description / Observatory

- Data sharing with the market. Protocol & Focal Point.
Knowledge base
 - Market offer description. Best practice criteria, integrity
 - Prospective: technologies and product road map
- > Manufacturer Practice: What are the data available and How they could be available
"Sponsors" Matra Bae & AMD
- > Focal point QA / SUCCESS
"Sponsors" Dassault Electronique & SUCCESS
- > Supply chain management: trends, key players and risk reduction techniques
"Sponsors" DERA & CALCE Consortium

Session 3 Component Performance Assessment Process

- Technology attributes for performance
 - Performance indicators, performance modelling & simulation.
 - Design & rating rules: component & board level
- > Performance modelling based on simulation management using VHDL-AMS
"Sponsors" Matra BAe , ENST & SUCCESS
- > The Motorola 68332 Microcontroller: A case study of uprating
"Sponsors" AlliedSignal & CALCE Consortium

Session 4 Component Reliability Assessment Process

- Packaging & Assembly Level Reliability
 - Reliability assessment based on analysis and simulation.
Sensitivity, Time to Failure, Life time
 - Design & rating rules: component & board level
- > Packaging & Assembly Level Reliability - Concept & Methodology
"Sponsors" Matra BAe & SUCCESS
Illustrated with:
Delamination story on PQFP using POF based simulation.
"Sponsors" Matra BAe & SUCCESS
Analysis of Solder Joints reliability as a function of different SMT
Processes
"Sponsors" IXL & Matra Marconi space
- > Motivation for a new parts selection and management program
"Sponsors" Aerospatiale & CALCE Consortium

Session 5 - Equipment & System Level Reliability Prediction

- Introduction of best practice reference to parametrize prediction models
 - Introduction of POF in "failure rate" based reliability prediction models
- > System reliability prediction using POF & field return analysis.
"Sponsors" Aerospatiale & SUCCESS
- > Operational reliability analysis of PR4G exploitation
"Sponsors" Thomson

Session 6 Standards for Assembly & Packaging Qualification, Certification

- What's available
- Applicability, consistency regarding real issues, performance specification requirements

> Industrial benefit of PURE Certification Program
"Sponsors" PURE: Thomson & Ericsson

Note: this programme may be subject to slight changes that in the worst case could affect speakers but in no way the content of the sessions. Final programme and agenda will be available during September 1998, on the ESREF WEB site:

<http://www.iae.dtu.dk/esref98>

W2 Power Devices Workshop: Thermal Management of Power Modules

Time: 14:00 - 17:30

Fee: No fee.

Workshop organizers: E. Wolfgang
Siemens AG, Corporate Technology
Germany, and
M. Ciappa
Swiss Federal Institute of Technology
Switzerland

The workshop on Thermal Management of Power Modules aims for an in-depth discussion of topics like: Thermal simulation, measurements of temperatures under real operating conditions, measurements of the thermal resistance and impedance, influence of different cooling systems, impact on the reliability, etc.

Experts from industry, universities and research institutes will be invited to give a short introduction to the state of the art.

W3 European Focused Ion Beam Users Group

Time: 10:00 - 17:00

Fee: No fee

Workshop organizer: D. Verkleij
 Philips Semiconductors
 The Netherlands

On October 5th, the second European Focused Ion Beam Users Group (EFUG) meeting will take place. For all FIB users this is a golden opportunity to partake in a meeting with fellow users.

As with last year this one day meeting will be divided into sessions addressing the various aspects of FIB usage:

- Circuit modification
- TEM sample preparation
- FIB as a material analysis tool
- Non semiconductor uses of FIB

Each individual session will be composed of contributions from users in the form of short presentations, (5-0 overheads), that show the latest innovations in FIB applications.

If you would like to partake, please contact:

D. Verkleij
Philips Semiconductors
Gertsweg 2
6534 AE Nijmegen
The Netherlands
Tlf. (+31) 24 353 2225
Fax. (+31) 24 353 3323
E-mail dick.verkley@nym.sc.philips.com

TUTORIALS

Tuesday, 6 October, 1998

The ESREF tutorials held on the morning prior to the opening of the technical sessions have become a popular feature of recent ESREF conferences.

The tutorials are included in the conference fee.

This year there are planned four tutorials, organized in two parallel sessions. Handouts will be available at the beginning of each tutorial session.

Tutorial Session 1

Chairman: Lars Rimestad, IAE, Denmark

8.30 T1 **Reliability of Ultrathin Gate Dielectrics**
R. Degraeve, IMEC, Belgium

In this tutorial, an overview of the present day physical understanding of oxide degradation and breakdown is presented. The following topics are treated:

- Basics of FN-tunneling, oxide degradation and breakdown, statistical representation of data and reliability predictions.
- Overview of the physical processes that occur during oxide degradation (charge trapping, interface trap creation, neutral trap creation, substrate current, stress-induced leakage current...) and their links with the breakdown event.
- Statistical modeling of the breakdown event and description of bimodal Weibull distributions.
- The field dependence of breakdown.
- Defect-related (extrinsic) breakdown: how to study, field dependence and importance for reliability predictions.

10.10 **COFFEE BREAK**

10.30 T2 **Scanning Near Field Optical Microscopy as Applied to Integrated Circuit Failure Analysis**
M. Utlaut, University of Portland, USA

A description of this tutorial may be found on the ESREF 98 web site.

12.10 **LUNCH BREAK**

Tutorial Session 2

Chairman: J. Møltoft, IAE, Denmark

8.30 T3 Quality and Reliability of Microchips N. Ahmad, IBM, USA

This workshop offers in-depth analysis of understanding and forecasting the quality and reliability of microchips.

Topics such as concept of quality and reliability, failure rate calculations, device hours, terminologies defining various failure rates, activation energies, microchip industry-based reliability models, temperature and voltage accelerators, significance of failure characterisation, failure rate prediction using CHI square statistics function with definite confidence levels are discussed along with case studies.

The tutorial also reviews the ASIC technologies for system level silicon products including copper interconnect, low dielectric constant, and performance and power dissipation factors.

10.10 COFFEE BREAK

10.30 T4 Microsystems and their Reliability S. Bouwstra, MIC, and J. Branbjerg, DELTA, Denmark

In the first half of the tutorial the status of the area of Microsystems will be presented, including an introduction to Microsystems, major processes and materials, examples of sensors, integration of transducers and electronics, applications, and manufacturing. Also the status of CAD tools for Microsystems will be briefly discussed. In the second half of the tutorial reliability issues will be discussed. Microsystems are compared with microelectronics, degradation mechanisms are discussed, as well as generic testing for Known-Good-Die on wafer level, and environmental and functional testing of packaged components. The tutorial finishes with a review of trends, including the issue of standardization of tests and specifications.

12.10 LUNCH BREAK

Tuesday 6-10-1998

14.00 **OPENING SESSION**

Chairman, F. Jensen, FJRC, Denmark
Co-chairman, C. Kjærgaard, IAE/DTU, Denmark

14.20 **Invited Paper: Full-chip Reliability Analysis**
D. Overhauser, Simplex Solutions, Inc., USA

15.00 **Invited Paper: The Quality and Reliability Supplement
to the SIA Roadmap - an Analysis**
R. Thomas, Technology Experts Network, USA

15.40 **COFFEE BREAK**

SESSION 1 FAILURE ANALYSIS AND CHARACTERISATION

Chairman, J.-P. Fortea, CNES, France
Co-chairman, M. Vanzi, University of Cagliari, Italy

16.00 1.1 **Invited paper: Applications of a Focused Ion Beam in
Failure Analysis**
D. Verkleij, Philips Semiconductors, The Netherlands

16.40 1.2 **Analysis of Iddq Failures by Spectral Photon Emission
Microscopy**
M. Rasras*, I. De Wolf*, H. Bender*, G. Groeseneken*, H.
E. Maes*, S. Vanhaeverbeke**, P. De Pauw**, *IMEC,
Belgium, **Alcatel-Microelectronics, Belgium

17.00 1.3 **Near-Field Optical Probe Induced Resistance Change
Detection (NF-OBIRCH) Methodm for Identifying
Defects In Aluminum And Titanium Silicide Interconnect**
K. Nikawa*, T. Saiki**, S. Inoue***, M. Ohtsu**** *NEC,
Japan, **Kanagawa Academy of Science and Technology,
Japan, ***Technology Development of Information Proces-
sing, Japan, ****Tokyo Institute of Technology, Japan

17.20 1.4 **A New Self-compensating Amplifier for Biased Electron
Beam Induced Current Applications**
M. Ciappa, Swiss Federal Institute of Technology,
Switzerland

Tuesday 6-10-1998

SESSION 2 POWER DEVICES

Chairman, E. Wolfgang, Siemens AG, Germany
Co-chairman, M. Ciappa, Swiss Federal Institute of
Technology, Switzerland

- 16.00 2.1 **Invited paper: Advanced IGBT Modules for Railway Traction Applications: Insulation and Explosions Testing, Reliability Testing**
R.W. Zehringer*, H. Berg**, E. Wolfgang*** *ABB, Switzerland, **EUPEC, Germany, ***Siemens AG, Germany
- 16.40 2.2 **Some Observation Dealing With the Failures of IGBT Transistors in High Power Converters**
S. Januszewski, M. Kociszewska-Szczerbik, H. Swiatek, Electrotechnical Institute, Poland
- 17.00 2.3 **Strain Depending Reliability of Automotive Diodes**
L. Galateanu*, M. G. Stoica*, E. Popa**, *National Institute for Microtechnologies-IMT, Romania, **S.C. Baneasa S.A., Romania
- 17.20 2.4 **Extrapolation of Cosmic Ray Induced Failures from Test to Field Conditions for IGBT Modules**
C. Findeisen, E. Herr, M. Schenkel, R. Schlegel, H. R. Zeller, ABB Semiconductors AG, Switzerland

Wednesday 7-10-1998

SESSION 3 POWER DEVICES

Chairman, E. Wolfgang, Siemens AG, Germany
Co-chairman, M. Ciappa, Swiss Federal Institute of
Technology, Switzerland

- 8.30 3.1 **Thermomechanical Deformation Imaging of Power Devices by Electronic Speckle Pattern Interferometry (ESPI)**
K. Nassim*, L. Joannes*, A. Cornet*, S. Dilhaire**, E. Schaub*, W. Claeys**, *Université de Louvain, Belgium, **Université Bordeaux 1, France
- 8.50 3.2 **On the Effect of Power Cycling Stress on IGBT Modules**
P. Cova*, F. Fantini**, *University of Parma, Italy, **University of Modena, Italy
- 9.10 3.3 **Temperature Measurements and Thermal Modelling of High Power IGBT Multichip Modules for Reliability Investigations in Traction Applications**
A. Hamidi* ***, G. Coquery*, R. Lallemand*, P. Vales**, J. M. Dorkel**, *New Technologies Laboratory, France, **LAAS, France, ***ABB, Switzerland
- 9.30 3.4 **Package Related Degradation Indicators of IGBT Power Modules**
M. Held*, G. Nicoletti*, P. Jacob*, P. Türkes**, *EMPA, Switzerland, **Siemens AG, Germany
- 9.50 3.5 **Reliability of Power Modules in an Inverter System**
T. Franke*, M. Honsberg-Riedel*, P. Simon**, J. Otto*, S. Ramminger*, G. Soelkner*, E. Wolfgang*, *Siemens AG, Munich, Germany, **Siemens AG, Erlangen, Germany
- 10.10 **COFFEE BREAK**

Wednesday 7-10-1998

SESSION 4 EOBT- ELECTRON AND OPTICAL BEAM TESTING

Chairman, L.J.Balk, Bergische Universität, Germany
Co-chairman, W. Claeys, Universté de Bordeaux 1, France

8.30 4.1 **Invited paper: Assembly and Analysis of Quantum Devices using SPM-based Methods**

L. Montelius, University of Lund, Sweden

9.10 4.2 **Circuit Internal Logic Analysis with Electric Force Microscope- (EFM-) Testing**

J. Bangert, E. Kubalek, Gerhard-Mercator-Universität Duisburg, Germany

9.30 4.3 **Failure Analysis of Integrated Devices by Scanning Thermal Microscopy (SThM)**

G.B.M. Fiege*, V. Feige*, J.C.H. Phang**, M. Maywald***, S. Görlich***, L.J. Balk*, *BUGH Wuppertal, Germany, **National University of Singapore, Singapore, ***Siemens AG, Germany

9.50 4.4 **Scanning Near-field Optical Microscopy Analyses of Electronic Devices**

R.M.Cramer*, W.R. Schade*, R. Heiderhoff*, L.J. Balk*, R. Chin**, *Bergische Universität Wuppertal, Germany, ** Intel Corp., USA

10.10 **COFFEE BREAK**

Wednesday 7-10-1998

SESSION 5 FAILURE ANALYSIS AND CHARACTERISATION

Chairman, Jean-Pierre Fortea
Co Chairman, Massimo Vanzi

- 10.30 5.1 **Detailed Investigation of SEM-results by TEM at One Sample Using FIB-technique**
U. Mühle, A. Wiesner, S. Schray, Siemens Microelectronics Center, Germany
- 10.50 5.2 **Induced Damages on CMOS and Bipolar Integrated Structures under Focused Ion Beam Irradiation**
J. Benbrik*, P. Perdu**, B. Benteo*, R. Desplats*, N. Labat***, A. Touboul***, Y. Danto***, *CNES-SOREP lab, France, **CNES, France, ***Université Bordeaux, France
- 11.10 5.3 **Junction Delineation & EBIC on FIB Cross-section**
G. Perez, F. Courtade, B. Nenteo, J. Lin-Kwang CNES, France
- 11.30 5.4 **Direct Observation of Local Strain Field for ULSI Devices**
N. Hashikawa, K. Fukumoto, T. Kuroi, M. Ikeno, Y. Mashiko Mitsubishi Electric Corporation, Japan
- 12.10 **LUNCH BREAK**

Wednesday 7-10-1998

SESSION 6 EOBT- ELECTRON AND OPTICAL BEAM TESTING

Chairman, L.J.Balk, Bergische Universität, Germany
Co-chairman, W. Claeys, Universté de Bordeaux 1, France

10.30 6.1 **A New Test Method for Contactless Quantitative Current Measurement via Scanning Magneto-resistive Probe Microscopy**

S. Bae*, A. Schlensog*, W. Mertin*, E. Kubalek*, M. Maywald**, *Gerhard-Mercator-Universität Duisburg, **Siemens AG, Germany

10.50 6.2 **Automatic Fault Tracing by Successive Circuit Extraction from CAD Layout Data with the CAD-Linked EB Test System**

K. Miura, K. Nakamae, H. Fujioka, Osaka University, Japan

11.10 6.3 **Cantilever Influence Suppression of Contactless IC-Testing by Electric Force Microscopy**

V. Wittpahl, U. Behnke, B. Wand, W. Mertin, Gerhard-Mercator-Universität Duisburg, Germany

11.30 6.4 **Application of Layout Overlay for Failure Analysis**

C. Burmer, S. Görlich, S. Pauthner, Siemens AG, Germany

11.50 6.5 **Failure Analysis of Wafer using OBIC Backside Method**

S. Ito*, H. Monma**, *Fujitsu VLSI Limited, Japan, **Fujitsu Limited, Japan

12.10 **LUNCH BREAK**

Wednesday 7-10-1998

SESSION 7 FAILURE ANALYSIS AND CHARACTERISATION

Chairman, J.-P. Fortea, CNES, France

Co-chairman, M. Vanzi, University of Cagliari, Italy

- 14.00 7.1 **A New Experimental Technique to Evaluate the Plasma Induced Damage at Wafer Level Testing**
L. Pantisano* **, A. Paccagnella* **, L. Pettarin*, A. Scarpa*, G. Valentini***, L. Baldi***, S. Alba*** *Università de Padova, Italy, **Unità INFM di Padova, Italy, ***SGS-Thomson Microelectronics, Italy
- 14.20 7.2 **Low Frequency Noise Analysis as a Diagnostic Tool to Assess the Quality of 0.25µm Ti-silicided Poly Lines**
E.P. Vandamme*, I. De Wolf*, A. Lauwers*, L.K.J. Vandamme**, *IMEC, Belgium, **Eindhoven University of Technology, The Netherlands
- 14.40 7.3 **A New Failure Criterion, Based on Noise Measurements, for the Evaluation of the Lifetimes of Metal Lines Subjected to Electromigration**
C. Ciofi*, V. Dattilo*, B. Neri*, S. Foley**, A. Mathewson**
*Dipartimento di Ingegneria dell' Informazione, Italy, **NMRC, Ireland
- 15.00 7.4 **Hot Carrier Degradation Mechanisms in Sub-micron p Channel MOSFETs: Impact on Low Frequency (1/f) Noise Behaviour**
E. Sheehan, P.K. Hurley, A. Mathewson, NMRC, Ireland
- 15.20 7.5 **Reliability of Nitrided Wet Silicon Dioxide Thin Films in WSi₂ or TaSi₂ Polycide Process: Influence of the Nitridation Temperature**
K. Yckache*, P. Boivin*, F. Baiget*, S. Radjaa**, G. Auriel**, B. Sagnes**, J. Oualid**, A. Glachant***
*STMicroelectronics, France, **ENSPM, France, ***CRMC2, France
- 15.40 **COFFEE BREAK**

Wednesday 7-10-1998

SESSION 8 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 14.00 8.1 **Invited paper: ESD Protection Methodology for Deep-submicron CMOS Technologies**
K. Bock, IMEC, Belgium
- 14.40 8.2 **Overview of the Kinetics of the Early Stages of Electromigration under Low (=realistic) Current Density Stress**
J.V.Olmen*, J.V.Manca*, W. De Ceuninck*, L. De Schepper*, L.M. Stals*, V. D'Haeger*, A. Witvrouw**, K. Maex**, L. Tielemans***, *Limburgs Universitair Centrum, Belgium, **IMEC, Belgium, ***DESTIN N.V., Belgium
- 15.00 8.3 **Effects of Alloying Elements on Electromigration**
R. Spolenak, O. Kraft, E. Arzt, Max-Planck-Institut für Metallforschung, Germany
- 15.20 8.4 **A Comparison Between Normally and Highly Accelerated Electromigration Tests**
S. Foley*, A. Scorzoni**, R. Balboni**, M. Impronta**, I. De Munari***, A. Mathewson* and F. Fantini***, *University College Cork, Ireland, **CNR - Istituto LAMEL, Italy, ***Università di Parma, Italy
- 15.40 **COFFEE BREAK**

Wednesday 7-10-1998

SESSION 9 MICROSYSTEMS RELIABILITY

Chairman, S. Bouwstra, Mikroelektronikcentret, Denmark
Co-chairman, J. Branebjerg, DELTA, Denmark

- 16.00 9.1 **Invited paper: Reliability of Industrial Packaging for Microsystems**
R. de Reus, Centre for Microelectronics, Denmark
- 16.40 9.2 **Analysis of Thermomechanical Stresses in a 3D Packaged Micro Electro Mechanical System**
C. Pellet*, M. Lecouvé*, H. Frémont*, A. Val**, D. Esteve**,
*Université Bordeaux 1, France, **LAAS, France
- 17.00 9.3 **Electrical Characterization and Modification of a MicroElectroMechanical System (MEMS) for Extended Mechanical Reliability and Fatigue Testing**
D. Meunier* ** ***, R. Desplats* **, J. Benbrik* **, C. Pellet**, D. Etséve***, B. Benteo****, *CNES, **IXL Laboratory, ***LAAS, ****SOREP, France
- 17.20 9.4 **Structures for Piezoresistive Measurement of Package Induced Stress in Transfer Molded Silicon Pressure Sensors**
J. B. Nysæther* ***, A. Larsen**, B. Liverød**, P. Ohlckers**
***, *University of Oslo, Norway, **SensoNor, Norway,
***SINTEF, Norway

Wednesday 7-10-1998

SESSION 10 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 16.00 10.1 **Electromigration Failure Modes in Damascene Copper Interconnects**
L. Arnaud*, R. Gonella**, J. Torrès***, C. Gounelle**, Y. Gobil*, G. Tartavel*, Y. Morand**, *LETI CEA-G, France, **SGS Thomson Microelectronics, France, ***CNET, France
- 16.20 10.2 **The Dependence of Stress Induced Voiding on Line Width Studied by Conventional and High Resolution Resistance Measurements**
A. Witvrouw*, K. Maex* **, W. De Ceuninck***, G. Lekens***, J. D'Haen***, L. De Schepper***, *IMEC, **INSYS, ***IMO, Belgium
- 16.40 10.3 **Lateral Interface Effect on Pulsed DC Electromigration Analysis**
P. Waltz*, L. Arnaud*, G. Lormand**, G. Tartavel*, *CEA LETI, France, **GEMPPM-INSA, France
- 17.00 10.4 **Mechanical Stress Evolution and the Blech Length: 2D Simulation of Early Electromigration Effects**
V. Petrescu*, A.J. Mouthaan*, W. Schoenmaker**, C. Salm*, *MESA Research Institute, The Netherlands, **IMEC, ASP-TCAD Division, Belgium

Thursday 8-10-1998

SESSION 11 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 8.30 11.1 **Systematic Derivation of Latchup Design Rules for Submicron CMOS Processes from Test Structures**
J. A. van der Pol*, P.B.M. Wolbert**, Waferfab AN, **Q&R Department, Philips Semiconductors, The Netherlands
- 8.50 11.2 **Reversibility of Charge Trapping and SILC Creation in Thin Oxides after Stress/Anneal Cycling**
P. Riess, R. Kies, G. Ghibaudo, G. Pananakakis, J. Brini, Laboratoire de Physique des Composants à Semiconducteurs, France
- 9.10 11.3 **Precise Quantitative Evaluation of the Hot-Carrier Induced Drain Series Resistance Degradation in LATID-n-MOSFETs**
G. H. Walter* **, W. Weber*, R. Brederlow* **, R. Jurk***, C.G. Linnenbank*, C. Schlünder*, D. Schmitt-Landsiedel**, R. Thewes*, *Siemens AG, ZT ME 2, **Technical University of Munich, ***Siemens AG, HL PI M, Germany
- 9.30 11.4 **On-Wafer Heating Tests to Study Stability of Silicon Devices**
D. Manic, Y. Haddab, R. S. Popovic, Swiss Federal Institute of Technology, Switzerland
- 9.50 11.5 **Characterization of SILC in Thin-oxides by Using MOSFET Substrate Current**
B. De Salvo* **, G. Ghibaudo*, G. Pananakakis*, F. Mondon**, *LPCS/ENSERG, **CEA/LETI, France
- 10.10 **COFFEE BREAK**

Thursday 8-10-1998

**SESSION 12 COMPOUND SEMICONDUCTOR AND
OPTOELECTRONIC RELIABILITY**

Chairman, F. Fantini, University of Modena, Italy
Co-chairman, G.M. Brydon, QaRel, United Kingdom

- 8.30 12.1 **Invited paper: Study of Degradation Mechanisms in Compound Semiconductor Based Devices by SEM-Cathodoluminescence**
G. Salviati, C.N.R. - MASPEC, Italy
- 9.10 12.2 **Degradation Behavior in InGaAs/GaAs Strained-Quantum Well Lasers**
T. Takeshita*, M. Sugo*, T. Nishiya**, R. Iga*, M. Fukuda*, Y.Itaya* *NTT Opto-electronics Laboratories, Japan,
**NTT Access Network Systems Laboratories, Japan
- 9.30 12.3 **Early Signatures for REDR-based Laser Degradations**
A. Bonfiglio*, M.B. Casu*, M. Vanzi*, R. De Palo**, F. Magistrali** G. Salmini**, *University of Cagliari, Italy,
**Pirelli Cavi S.p.A, Milano, Italy
- 9.50 12.4 **Coupling Technology Impact on Low-cost Laser Modules Performances and Reliability**
M. Morin, J.-P. Defars, P. Devoldère, France Télécom, France
- 10.10 **COFFEE BREAK**

Thursday 8-10-1998

SESSION 13 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 10.30 13.1 **Hot Carrier Induced Device Degradation in RF-nMOSFET's**
J. T. Park*, B. J. Lee*, D. W. Kim*, C. G. Yu*, H. K. Yu**
*University of Incheon, Korea, **Semiconductor Div., ETRI, Korea
- 10.50 13.2 **The Effect of Hot Electron Current Density on nMOSFET Reliability**
O. Buiu*, S. Taylor*, I. S. Al-Kofahi**, C. Beech***
*University of Liverpool, United Kingdom, **Yarmouk University, Jordan, ***MITEL Semiconductors, United Kingdom
- 11.10 13.3 **Dependence of Gate Oxide Breakdown on Initial Charge Trapping under Fowler-Nordheim Injection**
A. Martin* **, R. Duane*, P. O'Sullivan*, A. Mathewson*
*National Microelectronics Research Centre, Ireland, **Siemens AG, Germany
- 11.30 13.4 **Modelling and Simulation of Hot-carriers Degradation of High Voltage Floating Lateral NDMOS Transistors**
E. Vandenbossche*, C. De Keukeleire*, M. de Wolf**, H. Van Hove*, J. Witters*, *ALCATEL Microelectronics, Belgium, **University of Twente, The Netherlands
- 11.50 13.5 **A New Hot Carrier Degradation Law for MOSFET Lifetime Prediction**
B. Marchand*, G. Ghibaudo*, F. Balestra*, G. Guégan**, S. Deleonibus**, *Laboratoire de Physique des Composants à Semiconducteurs, France, **LETI-CEA, France
- 12.10 **LUNCH BREAK**

Thursday 8-10-1998

SESSION 14 COMPOUND SEMICONDUCTOR AND OPTOELECTRONIC RELIABILITY

Chairman, F. Fantini, University of Modena, Italy
Co-chairman, G.M. Brydon, QaRel, United Kingdom

- 10.30 14.1 **Failure Mechanisms of Schottky Gate Contact Degradation and Deep Traps Creation in AlGaAs/InGaAs PM-HEMT's Submitted to Accelerated Life Tests**
G. Meneghesso*, C. Crosato*, F. Garat**, G. Martines***, A. Paccagnella*, E. Zanoni*, *Universita' di Padova, Italy, **European Space Agency ESTEC, The Netherlands, ***Universita' di Cagliari, Italy
- 10.50 14.2 **Pulsed Current Stress of Berillium Doped AlGaAs/GaAs HBTs**
L. Cattani*, M. Borgarino*, F. Fantini* **, *DII, University of Parma, Italy, **DSI, University of Modena, Italy
- 11.10 14.3 **Reliability of Cu-Refractory Metallization GaAs-GaAlAs High Electron Mobility Transistors**
A. Dimoulas, M. Al-Sheikhly, T. Feng, A. Christou
University of Maryland, USA
- 11.30 14.4 **A New Method for Temperature Mapping on GaAs Field Effect Transistors**
E. Martin*, J. P. Landesman*, P. Braun**, A. Fily*
*Thomson-CSF, France, **United Monolithic Semiconductors GmbH, Germany
- 12.10 **LUNCH BREAK**

Thursday 8-10-1998

SESSION 15 FAILURE PREVENTION STRATEGIES

Chairman, A.C.Brombacher, TUE, The Netherlands
Co-chairman, D. Schmitt-Landsiedel, Technische
Universität Munich, Germany

- 14.00 15.1 **Invited paper: Wafer Maps in Integrated Circuit Manufacturing**
C.K. Hansen, Eastern University, USA, P. Thyregod, DTU, Denmark
- 14.40 15.2 **Field Failure Analysis on Transmission Data Equipment Due to Lightning Discharges**
E. Mino Diaz, J. E. Vila Aresté, Telefónica Investigación y Desarrollo, Spain
- 15.00 15.3 **Comparison Between Field Reliability and New Prediction Methodology on Avionics Embedded Electronics**
P. Charpenel*, P. Cavernes**, V. Casanovas*, J. Borowski**, J.M. Chopin*, *AEROSPATIALE Aéronautique, France, **GIAT Industries, France
- 15.20 15.4 **Improved Reliability of Bistable Circuits by Selective Hot-Carrier Stress Reduction**
A.G.M Das*, S. Johnson**, *Medical University of Southern Africa, South Africa, **University of Durham, United Kingdom
- 15.40 **COFFEE BREAK**

Thursday 8-10-1998

SESSION 16 PACKAGING

Chairman, C. Olsson, Ericsson, Sweden
Co-chairman, Jim Lloyd, Lloyd Technology Associates,
USA

- 14.00 16.1 **Invited paper, Electronic Packaging: Future Reliability Challenges**
J. Barrett, NMRC, Ireland
- 14.40 16.2 **A Concept to Relate Wire Bonding Parameters to Bondability and Ball Bond Reliability**
Z.N. Liang*, F.G. Kuper*, M.S. Chen**, *Philips
Semiconductors, The Netherlands, **Philips
Semiconductors, China
- 15.00 16.3 **Measurement of the Thermomechanical Behaviour of the Solder-lead Interface in Solder Joints by Laser Probing: A New Method for Measuring the Bond Quality**
S. Dilhaire**, A. Cornet*, E. Schaub**, C. Rauzan**, W. Claeys**, *Laboratoire FYAM, Université de Louvain, Belgium, **Laboratoire de Caractérisation de Composants Electroniques, Université Bordeaux, France
- 15.20 16.4 **Experimental Design and Evaluation of Interconnection Materials for Improvement of Joint Reliability at Power Transistors**
P. Jansson, Ericsson Radio Systems AB, Sweden
- 15.40 **COFFEE BREAK**

Thursday 8-10-1998

SESSION 17 FAILURE PREVENTION STRATEGIES

Chairman, A.C.Brombacher, TUE, The Netherlands
Co-chairman, D. Schmitt-Landsiedel, Technische
Universität Munich, Germany

- 16.00 17.1 **A Study of NMOS Behavior Under ESD Stress: Simulation and Characterization**
A.Z. Wang, C. Tsay, A. Lele, P. Deane, National
Semiconductor Corp. USA
- 16.20 17.2 **The Time of "Guessing" your Failure Time Distribution is Over!**
K. Croes*, J. V. Manca*, W. De Ceuninck*, L. De Schepper*,
G. Molenberghs**, *Limburgs Universitair Centrum,
Institute for Materials Research, Belgium, **Limburgs
Universitair Centrum, Belgium
- 16.40 17.3 **Extended Noise Analysis. A Novel Tool for Reliability Screening**
G. Härtler, U. Golze, K. Paschke, Ferdinand-Braun-Institut
für Höchstfrequenztechnik, Germany

Thursday 8-10-1998

SESSION 18 PACKAGING

Chairman, C. Olsson, Ericsson, Sweden
Co-chairman, Jim Lloyd, Lloyd Technology Associates,
USA

- 16.00 18.1 **Crack Mechanism in Wire Bonding Joints**
S. Ramminger*, P. Türkes*, G. Wachutka** *Siemens AG,
Germany, **Technical University of Munich, Germany
- 16.20 18.2 **Materials Interfaces in Flip Chip Interconnects for
Optical Components; Performance and Degradation
Mechanisms**
R. H. Esser*, A. Dimoulas*, N. Strifas*, A. Christou*, N.
Papanicolau** *University of Maryland, USA, **Naval
Research Laboratory, USA
- 16.40 18.3 **Best Paper, Japanese Reliability Symposium 1997,
A Study of Soldering Heat Evaluation for SMD's**
Y. Etoh, T. Kayama, K. Sasaki, Sony Corporation, Japan

Friday 9-10-1998

SESSION 19 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 8.30 19.1 **Recovery and Stress Dynamics in Bipolar Transistors and MOS Devices**
F. Ingvarson, L-Å. Ragnarsson, P. Lundgren, Chalmers University of Technology, Sweden
- 8.50 19.2 **Electrical Parameters Degradation Law of MOSFET During Ageing**
Ch. Mourrain, Ch. Tourniol, M. J. Bouzid, France Telecom CNET, France
- 9.10 19.3 **Investigation of the Intrinsic SiO₂ Area Dependence Using TDDDB Testing**
J. Prendergast*, N. Foley*, J. Suehle**, *Analog Devices, Ireland, **National Institute of Standards and Technology, USA
- 9.30 19.4 **Two-step Stress Method for the Dynamic Testing of Very Thin (8nm) SiO₂ Films**
R. Rodriguez, E. Miranda, M. Nafria, J. Suñé, X. Aymerich, Universitat Autònoma de Barcelona, Spain
- 9.50 19.5 **IRPS 1998, Best Paper, Disturbed Bonding States in SiO₂ Thin-Films and Their Impact on Time-Dependent Dielectric Breakdown**
J. McPherson, H. C. Mogul, Texas Instruments, USA
- 10.10 **COFFEE BREAK**

Friday 9-10-1998

SESSION 20 FAILURE MECHANISMS AND MODELLING

Chairman, G. Ghibaudo, LPCS, ENSERG, France
Co-chairman, A.J.Mouthaan, University of Twente, The Netherlands

- 10.30 20.1 **Temperature Dependence of Snap Back Breakdown up to 300°C Analyzed Using Circuit Level Model and Simulation**
D. Uffmann, Universität Hannover, Germany, Siemens AG, Semiconductors, Germany
- 10.50 20.2 **Modelling the Field Soft Error Rate of DRAMs by Varying the Critical Cell Change**
H. Schleifer*, O. Kowarik*, K. Hoffmann*, W. Reczek**
*University of Bundeswehr Munich, Germany, **Siemens, Munich, Germany
- 11.10 20.3 **Design of a Low EMI Susceptibility CMOS Transimpedance Operational Amplifier**
G. Setti, N. Speciale, Università di Bologna, Italy
- 11.30 20.4 **Gate Bias Stress in Hydrogenated and Unhydrogenated Polysilicon Thin Film Transistors**
B. Tala-Ighil*, A. Rahal** ***, H. Toutah*, K. Mourgues**, L. Pichon**, F. Raoult**, O. Bonnaud**, T. Mohammed-Brahim*
** *Site Universitaire, France, **, Université de Rennes 1, France, ***LCMS, Algeria
- 11.50 **CLOSING SESSION**
- 12.10 **Best Paper Awards**
Chairman, J. Møltøft, IAE/DTU, Denmark

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G. Coquery	INRETS, France

ESREF98 Conference week

	Monday			Tuesday		Wednesday		Thursday		Friday
8.30	W1 COTS	W2 Power Devices	W3 FIB	T1 Ultrathin Gate Dielectrics	T3 Quality and Reliability of Microchips	3 Power Devices	4 EOBT	11 Failure Mechanisms and Modelling	12 Compound Semiconductor Optoelectronic Reliability	19 Failure Mechanisms and Modelling
10.10	COFFEE									
10.30				T2 Scanning Near Field Optical Microscopy	T4 Microsystems and their Reliability	5 Failure Analysis	6 EOBT	13 Failure Mechanisms and Modelling	14 Compound Semiconductor Optoelectronic Reliability	20 Failure Mechanisms and Modelling
12.10	LUNCH									CLOSING SESSION Best Paper Award
14.00				OPENING SESSION		7 Failure Analysis	8 Failure Mechanisms and Modelling	15 Failure Prevention Strategies	16 Packaging	
15.40	COFFEE									
16.00				1 Failure Analysis	2 Power Devices	9 Microsystems Reliability	10 Failure Mechanisms and Modelling	17 Failure Prevention Strategies	18 Packaging	



DTU - The Technical University of Denmark

- The Technical University of Denmark (DTU) was founded by the Danish Scientist H. C. Ørsted in 1829. With its research and teaching potential DTU is now recognized as one of Europe's leading universities in the fields of technical science
- DTU covers all engineering disciplines. The university teaches to the M.Sc. and B.Sc. degrees as well as to a special engineering degree in food sciences. Additionally, there is an extensive ph.d. and continuing engineering education programme.
- The university has an intensive collaboration with leading Danish industries. A significant outcome of this collaboration has been the establishment of several research centres at DTU
- Financially, DTU is the Danish university that receives the most funding from external sources. The funding is used for pure research as well as for applied research.
- DTU has international student exchange agreements with more than 200 universities world wide. About one third of the university's students have gathered experience abroad in industries or at universities as part of their education.
- The staff comprises 1250 academic employees and 650 technical-administrative personnel.