



## **TASK FORCE meeting: Corrosion reliability of electronic devices**

**Place : Joffre 4**

**Time : 17:20 – 18:00 (Monday 12<sup>th</sup> September)**

**All are welcome**

# Agenda

- Presentation of Task Force
- TF activities – Possibility of a Midterm seminar/workshop (Continuation of 2015)
- Converting TF to a WP
- Publication of workshop papers as a special issue of CEST
- Workshop – Eurocorr 2017 (Eurocorr/ICC combined)
- TF Information net-work – restricted area under website
- AOB and summary

## **Task Force on “Corrosion reliability of electronics devices” established in 2014**

Enhanced corrosion performance of electronics and more reliable design is relevant for all industries, which needs collaborative effort between interdisciplinary areas namely electronics, electrical, and corrosion specialists enabling remedial measures based on proper understanding of corrosion and electrochemical mechanisms.

Presently reliability issues of electronics are discussed more in the Electronics/Electrical forums eg. IEEE, IMAPS conferences/seminars

The vision of this task group is to build the necessary interdisciplinary understanding required for solving the corrosion reliability issues at European level merging the expertise of various actors and to identify the industrial, and research and development needs, share knowledge and ideas, and develop information net-work.

# TF web page on EFC website



EUROPÄISCHE FÖDERATION KORROSION  
EUROPEAN FEDERATION OF CORROSION  
FÉDÉRATION EUROPÉENNE DE LA CORROSION

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Welcome -> Working Parties -> TF Corrosion reliability of Electronics

**EFC TASK FORCE: CORROSION RELIABILITY OF ELECTRONICS**

**MISSION:**  
Electronic devices, components, and products world-wide today face corrosion reliability issues resulting in premature fault and intermittent or permanent failures due to humidity exposure. The humidity related functionality issues and corrosion problems compromise the durability and reliability of the devices resulting in huge economic loss. Often a faulty signal or erroneous function by an electronic device is linked to the water layer formation on the surface of the printed circuit board assembly (PCBA) resulting from the humidity exposure and the water layer acting as electrolyte for electrochemical processes. Problem is compounded today due to a number of factors specific to the electronic devices such as miniaturization, high level of integration, and multi-material usage on the PCBA. These factors together with the applied potential bias when the device is working and contamination introduced during the manufacturing process causes a number of humidity related failure modes in electronics. Today electronic devices and control systems are part of almost all installations exposing them to all climatic conditions from clean room to severe offshore conditions.



**Metals and alloys**



Corrosion failure modes under humidity exposure conditions includes: leak current failures due to surface insulation reduction, electrochemical migration, galvanic corrosion due to micro-galvanic cell formation, creep corrosion, and corrosion caused by gaseous environment. Leak current and electrochemical migration issues are of particular importance due to the possibility of intermittent or permanent electrical functionalities issues causing device breakdown.

Both industrial electronics and consumer electronics suffer from corrosion reliability issues and the exposure conditions vary from humid to harsh environments. Therefore, incorporating enhanced corrosion performance in the design is relevant for all, which needs collaborative effort between interdisciplinary areas namely electronics, electrical, and corrosion specialists enabling remedial measures based on proper understanding of corrosion and electrochemical mechanisms.

The vision of this task group is to build the necessary interdisciplinary understanding required for

**Who we are**

**EFC Membership**

**Working Parties**

- WP Corrosion and Scale Inhibition
- WP Corrosion by Hot Gases and Combustion Products
- WP Nuclear Corrosion
- WP Environment Sensitive Fracture
- WP Surface Science and Mechanisms of Corrosion and Protection
- WP Corrosion Education
- WP Physico-chemical Methods of Corrosion Testing
- WP Marine Corrosion
- WP Microbial Corrosion
- WP Corrosion of Steel in Concrete
- WP Corrosion in Oil and Gas Production
- WP Coatings
- WP Corrosion in the Refinery Industry
- WP Cathodic Protection
- WP Automotive Corrosion
- WP Tribo-Corrosion
- WP Corrosion of Polymer Materials
- WP Corrosion and Corrosion Protection of Drinking Water Systems
- WP Corrosion of Archaeological and Historical Artefacts
- WP Corrosion Control in Aerospace
- TF CO<sub>2</sub> Corrosion in CCS-Applications
- TF Corrosion reliability of Electronics

**Events**

**Offers**

**Publications**

**EFC News**

**Chairman:**



Prof. Dr. Rajan Ambat  
Materials and Surface Engineering  
Department of Mechanical Engineering  
Technical University of Denmark  
DK 2800 Kgs. Lyngby  
Denmark  
Email: ram@mek.dtu.dk  
Tel: +45 - 45252181  
Fax: +45 - 45938213

**Vice-Chairman:**



Dr.-Ing. Helmut Schweigart  
Head of Technology Development  
ZESTRON Europe  
Bunsenstr. 6  
D - 85053 Ingolstadt  
Email: H.Schweigart@ZESTRON.com  
Tel.: + 49 (0) 841 / 635 - 29

**TF Initiated in 2014**

## **WS as part of Eurocorr 2013 - 2015**

2013 – Half day session – 6 presentations

2014 – 1 day session – 15 presentations (*13 + 2 transferred from another session*)

2015 – 1 day session – 12 presentations

2016 – 1.25 days session – 18 presentations (2 key notes) + 4 posters

Joffre 4		Corrosion Reliability of Electronics Devices and Materials
Chair(s)		<i>H. Schweigart / M.S. Jellesen</i>
13:40	O-69875	<b>An overview on the corrosion reliability of electronics</b> Rajan Ambat (Center for Electronic Corrosion, Materials and Surface Engineering, Department of Mechanical Engineering, Technical University of Denmark)
14:00	K-69885	<b>Keynote Lecture</b> <b>Reliability of electrics and electronics in an automotive context; Examples addressing encapsulations and humidity dynamics</b> Mats Ström (Volvo Car Group)
14:30	K-69930	<b>Keynote Lecture</b> <b>Material and Process Influences on conductive anodic filament formation</b> David Humby (Isola Group)
15:00	O-64497	<b>Thermal effects in electronic systems: new results on electrochemical corrosion and their correlations</b> Katharina Schultz (Robert Bosch GmbH) / Felix Petri (Robert Bosch GmbH)
15:20	O-69895	<b>Interpretation of corrosion observed after IPC humidity test on PCB's with various flux types and electrical loads.</b> Annemette Riis (Grundfos Holding A/S) / Allan Hjarbaek Holm (Grundfos Holding A/S) / John B. Jacobsen (Grundfos Holding A/S) / Jens Peter Krog (Grundfos Holding A/S) / Jakob Harming (Grundfos Holding A/S) / Lars Rimestad (Grundfos Holding A/S)
15:40	<b>Coffee Break</b>	
Joffre 4		Corrosion Reliability of Electronics Devices and Materials
Chair(s)		<i>R. Ambat / M.S. Jellesen</i>
16:10	O-50932	<b>Procedure comparison for estimating the PCBA service life at moist climate exposure</b> Helmut Schweigart (Dr. O.K. Wack Chemie GmbH)
16:30	O-52937	<b>Investigation of the influence of electrochemical migration (ECM) on the reliability of electronic assemblies after rework using lead-free solders and No-clean flux mixtures</b> Helge Schimanski (Fraunhofer-Institut für Siliziumtechnologie ISIT) / Olga Yezerska (Fraunhofer Institut fuer Fertigungstechnik und Angewandte Materialforschung- IFAM) / Peter Plagemann (Fraunhofer Institut fuer Fertigungstechnik und Angewandte Materialforschung- IFAM) / Jürgen Hagge (Fraunhofer-Institut für Siliziumtechnologie - ISIT )
16:50	O-62522	<b>Characterization of humidity effects on electronics by means of impedance spectroscopy</b> Vadimas Verdingovas (Technical University of Denmark (DTU)) / Morten Stendahl Jellesen (Technical University of Denmark) / Rajan Ambat (Technical University of Denmark)
17:10	O-59767	<b>Electrochemical migration of Ni and ENIG surfaces finishes during thermal humidity bias test</b> Bálint Medgyes (Budapest University of Technology and Economics (BME))

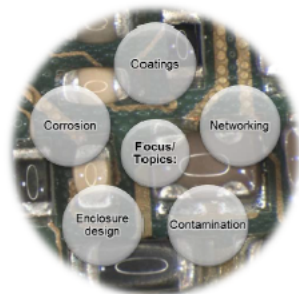
Joffre 4		Corrosion Reliability of Electronics Devices and Materials
Chair(s)		<i>R. Ambat / H. Schweigart</i>
8:40	O-60452	<b>Effect of hygroscopic atmospheric particles deposition on the corrosion reliability of electronics</b> Luca D'Angelo (University of Milano-Bicocca) / Verdingovas Vadimas (Technical University of Denmark, Department of Mechanical Engineering ) / Luca Ferrero (University of Milano-Bicocca, Department of Earth and Environmental Science) / Ezio Bolzacchini (University of Milano-Bicocca, Department of Earth and Environmental Science) / Rajan Ambat (Technical University of Denmark, Department of Mechanical Engineering)
9:00	O-63832	<b>Dynamics of moisture ingress in second and first level housings</b> Helene Conseil (Technical University of Denmark) / Gerald Hamm (Robert Bosch GmbH, Automotive Electronics) / Lutz Müller (Robert Bosch GmbH, Automotive Electronics) / Mathias Hain (Robert Bosch GmbH, Automotive Electronics) / Rajan Ambat (Technical University of Denmark)
9:20	O-55312	<b>Practical humidity ingress in electronic enclosures</b> Kim Albert Schmidt (DELTA) / Anders Bonde Kentved (DELTA)
9:40	O-70090	<b>Choosing the right No Clean chemistry for lead free solder paste in Vapor Phase Reflow</b> Emmanuelle Guéné (Inventec Performance Chemicals)
10:00	O-64752	<b>Simple standardized corrosion measurement of semiconductor metallizations</b> Lutz Müller (Robert Bosch GmbH) / Johann Bartha (TU Dresden) / Sophie Louise Mach (TU Dresden)
10:20	<b>Coffee Break</b>	
Joffre 4		Corrosion Reliability of Electronics Devices and Materials
Chair(s)		<i>R. Ambat / H. Schweigart</i>
10:50	O-62342	<b>Electronics device level testing and visualization of tin corrosion on printed circuit boards</b> Morten Stendahl Jellesen (Technical University of Denmark) / Vadimas Verdingovas (DTU) / Helene Conseil (DTU) / Rajan Ambat (DTU)
11:10	O-60972	<b>Degradation of wetness sensors exposed to maritime atmosphere</b> Oleg Startsev (All-Russian Scientific-Research Institute of Aviation Materials) / Maksim Molokov (All-Russian Scientific-Research Institute of Aviation Materials) / Ivan Medvedev (All-Russian Scientific-Research Institute of Aviation Materials (FSUE))
11:30	O-59602	<b>Thermal stability of electroplated tin-nickel alloy: study on microstructure and electrochemical proper</b> Peter Jensen (Department of Mechanical Engineering, Technical University of Denmark) / Visweswara C. Gudla (Department of Mechanical Engineering, Technical University of Denmark) / Rajan Ambat (Department of Mechanical Engineering, Technical University of Denmark)
11:50	P-59512	<b>Corrosion failure analysis of hearing aid battery-spring contacts</b> Visweswara Gudla (Section of Materials and Surface Engineering, Department of Mechanical Engineering, Technical University of Denmark) / Morten Jellesen (Section of Materials and Surface Engineering, Department of Mechanical Engineering, Technical University of Denmark) / Rajan Ambat (Section of Materials and Surface Engineering, Department of Mechanical Engineering, Technical University of Denmark)
12:30	<b>Lunch</b>	

# Activity during last year



A full day seminar on

## Climatic reliability of Electronics: Global challenges and Perspectives



28th January 2016

Technical University of Denmark  
DK 2800 Kgs. Lyngby, Denmark  
DK 2800 Kgs. Lyngby, Denmark, Building 101, Room S09

[www.inspe.mek.dtu.dk](http://www.inspe.mek.dtu.dk)  
[www.Celcorr.com](http://www.Celcorr.com)

### Who should attend?

- Reliability engineers
- Technology forecasters
- Corrosion engineers and specialists
- Researchers and academics

Climatic reliability is a serious issue today for electronic devices, components, and bare printed circuit boards (PCBs) due to number of factors. Therefore the protection of interior parts from external conditions is a critical factor. Interaction of humidity with internal parts such as Printed Circuit Board Assembly (PCBA) can cause several functionality issues due to corrosion. Humidity related problems in electronics is a combination of material, corrosion, and electrical issues, which leads to reduced life span of the products and heavy economic loss due to failures. The miniaturization and explosive increase in the use of electronics has increased the demand for climatically reliable electronics.

Both industrial electronics and consumer electronics suffer from climatic reliability issues, which includes application such as in humid and harsh environments. Therefore, incorporating enhanced corrosion performance in the design is relevant for all, which needs interaction between electronics, electrical, and corrosion specialists.

The seminar will address the following important issues:

Current state and future perspectives from leading industrial manufacturers	Corrosion failure modes and mechanisms in electronics	Physics of failure approach to humidity related issues
Process cleanliness, PCBA design aspects, and water layer formation	Corrosion mitigation and prediction strategies for electronics	Specific corrosion issues related to materials and components in electronics
Issues related to the use of polymers in electronics and corrosion	Importance of enclosure design and packaging for humidity effects	Modelling of humidity effects on electronics

The seminar will end with an open buffet and opportunities for networking / pre-booked with other delegates.

Seminar attracts delegates from academia and industry. We are delighted to invite you to attend this important seminar.

### Organizers:

Professor Rajan Ambat, CELCORR, DTU  
Dr. Morten Jellesen, CELCORR, DTU  
Dr. Daniel Minzari, IPU

### Expected Fee for attendees:

Members of ATV-SEMAPP: DKK: 2500; Others: DKK: 3000. The fee covers food and conference materials.

### Registration:

Please use the following link: [www.b2match.eu/in-spe-2016](http://www.b2match.eu/in-spe-2016)

The full day seminar on "Climatic reliability of electronics: Global challenges and perspectives" is organized as part of the INSPE Consortium and 5<sup>th</sup> Anniversary of the CreCon industrial consortium at DTU<sup>1</sup>. Event is also a part of the activity under the EFC Task Force on "Corrosion Reliability of Electronics."

<sup>1</sup> INSPE - Innovation consortium for sustainable performance in electronics  
Partners: DTU, DELTA, IPU, Danfoss, Grundfos, Vestas, Eltek, Velux  
CreCon - Industrial consortium for corrosion reliable electronics, Center for Electronic Corrosion, DTU ([www.celcorr.com](http://www.celcorr.com))

Mid-term TF meeting



# Possible interest in Europe



- Attending workshop/shown interest in TF activities
- Groups active on corrosion reliability issues



# *Theme issue: Corrosion reliability of electronics*

**Proposal for  
*Corrosion Engineering, Science and Technology,*  
covering  
**‘Corrosion reliability of electronics’****

Guest edited by **Professor Rajan Ambat**  
(Technical University of Denmark)

Please discuss prospective papers with Rajan Ambat or visit the Taylor & Francis booth (#27A) if you are interested in contributing

# Actions:

- Presentation of Task Force
- TF activities – Possibility of a Midterm seminar/workshop (Continuation of 2016 at DTU) – It is interesting and plan to arrange in January 2017 at DTU, Denmark
- Converting TF to a WP – Agreed that it is time to start WP and all attendees will help in getting support letters.
- Publication of workshop papers as a special issue of CEST – Rajan will see how many papers can get for this issue and a decision will be taken based on this.
- Workshop – Eurocorr 2017 (Eurocorr/ICC combined) – All attendees agreed to to continue this effort and will provide support. More publicity will be made for getting papers.
- TF Information net-work – restricted area under website
- AOB and summary – Rajan will inform participants on upcoming activities. Another suggestion was to tie up with electronics associations such as IEEE, IMAPS etc.