

REPORT DOCUMENTATION

AFRL-SR-BL-TR-98-

0565

Approved
0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour gathering and maintaining the data needed, and completing and reviewing the collection of information, including suggestions for reducing this burden, to Washington, Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management

using existing data sources, or any other aspect of this data Reports, 1215 Jefferson Avenue, N. W., Washington, D. C. 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE		3. PERIOD OF PUBLICATION AND DATES COVERED FINAL 01 Apr 98 To 30 Sep 98	
4. TITLE AND SUBTITLE 1998 GORDON CONFERENCE ON AQUEOUS CORROSION			5. FUNDING NUMBERS F49620-98-1-0107 2303/BS 61102F		
6. AUTHOR(S) DR CARLYLES B. STORM					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) GORDON RESEARCH CENTER - URI GORDON RESEARCH CONFERENCES INC. P.O. BOX 984 KINGSTON RI 02892-0984			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NL 110 DUNCAN AVE ROOM B115 BOLLING AFB DC 20332-8050 MAJ HUGH C. DE LONG			10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) The Gordon Research Conferences were established to foster the open sharing of new scientific findings and theories between researchers in specific fields. Unlike most other conferences, a full week is dedicated to presentations in one area. The talks and discussions at this conference on Aqueous Corrosion were of such a duration to allow indepth exposition and full discussion of each session topic. Speakers were selected by the chair for their expertise and recent progress in areas deemed to be at the frontiers of corrosion science and technology. Another key aspect of the conference is accessibility. Substantial opportunity was provided for informal discussions outside the lecture program during meals, free afternoon periods, and late evening gatherings. All attendees were also given the opportunity to present their own work through poster sessions. This format was particularly helpful for graduate students and new researchers in the field in establishing personal contacts with the international corrosion research community.					
14. SUBJECT TERMS				15. NUMBER OF PAGES	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT (U)		18. SECURITY CLASSIFICATION OF THIS PAGE (U)		19. SECURITY CLASSIFICATION OF ABSTRACT (U)	
				20. LIMITATION OF ABSTRACT (UL)	

1998 GORDON CONFERENCE ON AQUEOUS CORROSION

Final Progress Report

NSF Grant Number: DMR-9800550

By

J. Douglas Sinclair, Chairman

Email: ntcg@lucent.com

Phone: (908) 582-3345

Fax: (908) 582-3574

Bell Laboratories, Lucent Technologies
600 Mountain Avenue
Murray Hill, NJ 07974

Submitted July 17, 1998

19980813 006

1998 Gordon Conference on Aqueous Corrosion

FINAL PROGRESS REPORT

NSF Grant No. DMR-9800550
AFOSR Grant No. F 49620-98-1-0107
ONR Grant No. N 00014-98-1-0069

INTRODUCTION

The Gordon Research Conferences were established to foster the open sharing of new scientific findings and theories between researchers in specific fields. Unlike most other conferences, a full week is dedicated to presentations in one area. The talks and discussions at this Conference on Aqueous Corrosion were of such a duration to allow in-depth exposition and full discussion of each session topic. Speakers were selected by the chair for their expertise and recent progress in areas deemed to be at the frontiers of corrosion science and technology.

Another key aspect of the conference is accessibility. Substantial opportunity was provided for informal discussions outside the lecture program during meals, free afternoon periods, and late evening gatherings. All attendees were also given the opportunity to present their own work through poster sessions. This format was particularly helpful for graduate students and new researchers in the field in establishing personal contacts with the international corrosion research community.

FOCUS OF THE 1998 CONFERENCE ON AQUEOUS CORROSION

The conference theme was Materials Reliability Through Corrosion Research. The conference focused on recent advances in understanding the fundamentals of aqueous corrosion of metals, the formation and breakdown of oxide films, the behavior of coating and protective layers, reliability prediction, new surface characterization techniques, corrosion issues with fluid delivery systems and infrastructure materials, and other currently important scientific and technological topics.

Individual sessions were:

- Corrosion Research Applied to Power Generation
- Fundamental Processes on Surfaces
- Corrosion/Reliability Prediction
- Integrity/Structure of Passive Films
- Corrosion Mechanisms and Prevention in Fluid Delivery Systems
- Localized Corrosion
- Reliability of Coatings/Protective Films for Corrosion Prevention
- Corrosion Mechanisms and Prevention with Infrastructure Materials
- Corrosion Research Beyond the Year 2000

The complete program and a listing of speaker's addresses are attached. Emphasis in the selection of speakers was on young scientists, while discussion leaders tended to be senior scientists. Speakers from Japan, France, Australia, Switzerland, Sweden, Canada, United Kingdom, and Germany were included in the program. Attendees represented 18 different countries, including 3 people each from Russia and China.

A highlight of the Conference was the poster session. Presenters were given the opportunity for a short oral summary of the posters at the technical sessions, and this was very successful. The winners of the best student/postdoc and best overall poster were appropriately recognized.

Attendance at this Conference was the best it has been in many years. Over 175 people applied. The available space in the meeting room limited attendance to 130.

Summaries of Specific Sessions

Corrosion Research Applied to Power Generation

The conference program began with presentations on corrosion research in power generation. Dr. Peter Andresen from General Electric R&D Center gave a presentation on mechanisms of stress corrosion cracking (SCC) of Fe- and Ni-based alloys in boiling water and pressurised water reactor environments. Dr. Andresen's comments focused on key environmental, metallurgical, and mechanical variables that influence SCC. Specific attention was given to how these variables can be accurately represented in predictive models. A second presentation, given by Prof. David Shoesmith from Western Ontario University, outlined the Canadian and U.S. concepts for long-term storage of radioactive nuclear wastes. Shoesmith illustrated how predictive models for long term performance scenarios ($> 10,000$ years) can be constructed by breaking the problem down into segments that are defined on the basis of changes in the storage environment. Shoesmith made the point that changes in the environment induce changes in the predominant corrosion damage accumulation mechanism, making this approach to long-term modelling sensible and attractive. Both presentations were followed by vigorous discussions which focused on complications in predictive modelling due to variability in experimental corrosion data, and uncertainty in our mechanistic understanding of corrosion processes. The session clearly underscored the magnitude of the scientific and technological challenges associated with predictive modelling of corrosion damage processes.

Fundamental Processes on Surfaces

The session, "Fundamental Processes on Surfaces" featured two speakers, Prof Jerry Frankel (Ohio State University) and Prof Karl Sieradzki (Arizona State University). Professor Frankel discussed "Studies of Localized Corrosion by Scanning Kelvin Probe

Force Microscopy and AFM Scratching". He reviewed several AFM and AFM-like techniques that give high resolution images of surfaces, although not all the techniques use AFM instruments. He described his own work in which metal alloy surfaces are imaged in air. The imaging is intended to reveal the local surface potential of the metal by Kelvin probe measurements with an AFM instrument. When the probe is scanned in contact mode, the surface is abraded ("scratched") and this causes a residual damage to the surface. In the tapping mode, less surface perturbation is found and it is in this mode that the surface potential measurements are made. The talk was well received, and discussion was lively regarding interpretation of the measurements.

Prof Sieradzki's talk, "Electrochemical Processing of Materials by Dealloying" described work to fabricate metal layers with low surface defect density by alternating deposition/dissolution processing. The voltage step and swing procedure is designed to take advantage of underpotential deposition followed by dealloying and deposition stages. One finally obtains pure metal surfaces that have a high degree of perfection. The discussion was again very extensive with questions about the metal systems to which the strategy could be applied. Both talks reflected the strengths of the speakers and were new developments of importance in corrosion science.

Corrosion/Reliability Prediction

The session on corrosion and reliability prediction considered two areas of contemporary importance and great complexity. The talk by Ivan Cole, CSIRO, Australia considered atmospheric corrosion as it occurs in Australia from the point of view of relating the source of corrosive chemicals to detailed mechanistic corrosion processes that occur on substrate metals. Of particular interest was the correlation of wave height in the South Pacific Ocean surrounding Australia with the source of corrosive chemicals. The talk by Jeff Braithwaite, Sandia National Laboratory considered the complexity of corrosion of microelectronic systems where the occurrence of corrosion is widely thought to be impossible to analyze on a detailed basis. The talk described an approach with a probabilistic format. This approach enables including unforeseen failure mechanisms while accounting for corrosion processes that can be identified.

Integrity/Structure of Passive Films

This session was devised as an "appetizer" to the forthcoming 8th International Symposium on Passivity of Metals and Semiconductors. It featured presentations on passivity of metals and alloys, and on passivation of microelectrode arrays. The paper by Virtanen, Swiss Federal Institute of Technology, on critical factors in the stability of passive films provided new results obtained using a variety of advanced surface characterization techniques, including new studies using a synchrotron light source. The talk provoked considerable discussion. J. W. Schulze, Heinrich-Heine-University introduced some novel approaches to the development of microelectrode arrays. The paper emphasized the importance of studying passivity at both short times and on atomic-scale structures. The talk stimulated a vigorous, wide-ranging discussion.

Corrosion Mechanisms and Prevention in Fluid Delivery Systems

Professor Mark Orazem, University of Florida, discussed using electrochemical impedance methods to derive fundamental information on reaction mechanisms that take place during fluid flow at electrochemical interfaces. Of particular interest was the discussion of his very new approach to generate this information – electrohydrodynamic impedance. The method generates small AC current signals by perturbing the rotation speed of the electrode, thereby modifying the mass transport conditions and the resulting electrochemical currents. It is a very clever and sophisticated method for deriving mechanistic information which can not be determined by other available methods. The presentation, and particularly the new method, stimulated a great deal of lively and creative discussion.

Professor Paul Jepson, Ohio University, presented an excellent tutorial on multiphase flow of oil, water, and gas, and an outstanding description of the various approaches his laboratory is utilizing to understand and to solve the wide range of often very severe problems in these multiphase systems. Historically, these problems have been managed by empirical approaches and with varied success. The fundamental and systematic approaches discussed in this lecture are very new and hold great promise for improving the understanding of and control of the corrosion processes in these systems. The discussion period was again very lively, and a number of attendees were stimulated to initiate collaborative work with Jepson, or new work on their own.

Localized Corrosion

Francois Huet, University of Paris, gave a talk on the application and value of electrochemical noise measurements as applied to corrosion. He gave a detailed accounting of how to make such measurements. He presented several contrasting aspects of noise data and offered sophisticated interpretations. This work is clearly at the frontier of noise measurements in corroding systems

Rob Kelly, University of Virginia, presented a comprehensive discussion on what controls crevice corrosion morphology, based on analytical data obtained using several different techniques. He offered his views on the critical factors responsible for the geometric and topographical features of crevices, which provoked considerable discussion.

Reliability of Coatings/Protective Films for Corrosion Prevention

Professor Martin Stratmann of Friedrich-Alexander-Universitat Erlangen-Nurnberg gave a talk on new ways of protecting materials against corrosion using surface modification by ordered monolayers. The disbondment of coated metals due to corrosion processes leads to the eventual failure of the coating to protect the underlying metal. In-situ scanning Kelvin probe analysis was used to follow the process of disbondment of coatings on iron and aluminum alloys. The mechanism of disbondment on the two alloy systems was discussed in light of the in-situ analysis as well as more conventional ex-situ

techniques such as XPS. An innovative approach using ordered monolayers to improve both the adhesion and stability of coatings on iron and aluminum alloys was also discussed. Attendees were excited by this work.

Professor Barbara Shaw, Pennsylvania State University, discussed the preparation of non-equilibrium alloys and what makes them protective. The elements that can be used to ally magnesium and aluminum are limited by the low solubilities of these alloying elements in aluminum and magnesium. In the work presented here, non-equilibrium alloying techniques were used to produce single phase solid solution alloys that exceeded the solid-solubility limits of the alloying elements and increased the corrosion resistance. XPS and scanning and transmission microscopies were used to analyze the resultant alloys and explain the mechanism of corrosion protection.

Corrosion Mechanisms and Prevention with Infrastructure Materials

Graham Wood, UMIST, began this session by pointing out that the two speakers would be dealing with the subject of sustainable development, a subject that is currently exercising many governments around the world.

Professor John Scully, University of Virginia, presented work on fundamental processes associated with corrosion and protection of steel reinforced concrete structures. On the technological side, he concluded from his work that hydrogen concentration-based criteria are more informative and that safe cathodic protection windows are possible to define but the mechanism of life-extension remains uncertain. On the scientific side he concluded that calcium hydroxide promotes hydrogen entry and hydrogen damage is initiated by a ductile lamellae shearing process. Criteria discussed included the efficacy of polarization above and below and water line; development of a "safe" cathodic protection method; the relationship between fracture toughness and hydrogen concentration.

Professor Christofer Leygraff, Royal Institute of Technology, talked about the release of metals from the technosphere to the biosphere. He concluded that atmospheric corrosion rates have decreased substantially over the last few decades and runoff rates of metals are frequently lower than corrosion rates. The relationship between the corrosion rate and runoff was discussed. The critical question is the bio-availability of the metal during runoff. In discussion it was clear this depended not only on the metal but on the system and the mode/mechanism of presentation of the metal.

Corrosion Research Beyond the Year 2000

The Conference concluded with a discussion on the future direction of corrosion research. It began with a brief history of the Gordon Conference by Roger Staehle and then the five invited panelists, Koji Hashimoto of Tokoku University, Jerry Kruger from Johns Hopkins University, Alison Davenport from the University of Manchester, Martin Kendig from the Rockwell International Science Center, and Roger Newman from the UMIST, Corrosion and Protection Centre. Ron Latanision, Massachusetts Institute of

Technology, moderated the discussion. The panels comments led to a vigorous, far-reaching discussion on the proper balance between corrosion science and corrosion engineering. Some of the panelists and attendees espoused the view that there are three critical aspects to corrosion prevention that need attention: (1) research on molecular scale chemical and physical processes associated with the corrosion of materials and its prevention; (2) corrosion engineering of components (such as transportation vehicles) and structures; (3) understanding and approaches for managing the complexity inherent in corrosion in large scale systems such as nuclear power plants, electronic devices, and materials or devices that must survive in everchanging environments.

SPEAKER LIST

Dr. Peter Andresen
General Electric Company
Research and Development
Schenectady, NY

Phone:
Fax: 518-387-7007
Email: andresen@exc01crdge.crd.ge.com

"Mechanism of Stress Corrosion Cracking of Iron-Based Alloys"

Dr. David Shoesmith
AECL Research
Pinawa, MB
Canada

Phone:
Fax: 204-753-2455
Email: shoesmid@aecl.ca

"The Development of Containment Models for Environmental Performance Assessment in the Field of Nuclear Waste Disposal"

Professor Gerald Frankel
Dept of Mat Sci and Eng
477 Watts
Ohio State University
2041 N. College Road
Columbus, OH 43210

Phone:
Fax: 614-292-1537
Email: frankel.10@osu.edu

"Studies of Localized Corrosion by Scanning Kelvin Probe Force Microscopy and AFM Scratching"

Professor Karl Sieradzki
Program in Mechanics and Materials
Dept. of Mechanical and Aerospace
And Center for Solid State Sciences
Arizona State University
Tempe, AZ 85289

Phone:
Fax: 602-965-1384
Email: karl@icarus.eas.asu.edu

"Electrochemical Processing of Materials by Dealloying"

Ivan Cole
CSIRO Division of Building,
Construction and Engineering
P. O. Box 56 Graham Road
Highett 3190 VIC
Australia

Phone:
Fax:
Email: Ivan.Cole@dbce.csiro.au

"The Role of Surface Chemistry in the Atmospheric Corrosion of Zinc and Al-Zn Coatings: Progress Towards a Holistic Model"

Dr. Jeffrey Braithwaite
Sandia National Laboratories
MS 0340
Albuquerque, NM 87185

Phone:
Fax: 505-284-3922
Email: jwbrait@sandia.gov

“Physical Models for Predicting the Effect of Corrosion on Microelectronic Reliability”

Dr. Sanna Virtanen
Institute of Materials Chemistry and
Corrosion
Swiss Federal Institute of Technology
ETH-Hoenggerberg
8093 Aurich, Switzerland

Phone:
Fax: 41-1-633-1147
Email: virtanen@ibwk.baum.ethz.ch

“Critical Factors in the Stability of Passive Films”

Professor J. Walter Schultze
Inst Fur Phys & Elektrochem
Heinrich-Heine-University
Universitätsstr 1 GEB 26.32
40225 Dusseldorf 1, Germany

Phone:
Fax: 49-211-81-12803
Email:

“Passivation and Corrosion of Microelectrode Arrays”

Professor Mark Orazem
Dept of Chem Eng
University of Florida
Gainesville, FL 32611

Phone:
Fax: 352-392-9513
Email: meo@electro.che.ufl.edu

“Applications of Electrochemical Impedance Spectroscopy for Flow Enhanced Corrosion”

Professor Paul Jepson
Ohio University
Athens, OH 45701

Phone:
Fax: 614-593-0873
Email: jepson@bobcat.ent.ohiou.edu

“The Effect of Multiphase Flow on Sweet Corrosion in 3 Phase Oil/Water/Gas Pipeline Delivery Systems”

Dr. Francois Huet
Laboratory of Physics of Liquids and
Electrochemistry
UPR 15 CNRS
University of Paris 6
Tour 22/12, UPMC, 4 Place Jussieu
75252 Cedex 05, Paris
France

Phone:
Fax: 33-144-274074
Email: frh@ccr.jussieu.fr

“Electrochemical Noise Applied to Corrosion”

Professor Rob Kelly
Dept of Materials Science and Eng
University of Virginia
Thornton Hall
Charlottesville, VA 22903

Phone:
Fax: 804-982-5799
Email: rgk6y@virginia.edu

“What Controls Crevice Corrosion Morphology”

Professor Martin Stratmann
Friedrich-Alwaxander-Universitat
Erlangen-Nurnberg
Institut fur Werkstoffwissenschaften
Lehrstuhl fur Korrosion und
Oberflachentechnik
Martensstrasse 7

Phone:
Fax: 49-9131-85-7582
Email: stratman@ww.uni-erlangen.de

***“Surface Modification by Ordered Monolayers: New Ways of
Protecting Materials Against Corrosion”***

Professor Barbara Shaw
Pennsylvania State University
211 Hallowell Bldg
University Park, PA 16802

Phone:
Fax: 814-863-0490
Email:

“Amorphous Magnesium Alloy Films – What Makes Them Protective”

Professor John Scully
Dept of Materials Science and Eng
University of Virginia
Thornton Hall
Charlottesville, VA 22903

Phone:
Fax: 804-982-5799
Email: jrs8d@uva.pcmail.virginia.edu

***“Corrosion and Protection of Steel Pre-stressed Concrete Structures:
Scientific Issues”***

Professor Christofer Leygraf
Dept of Materials Science and Eng
Royal Institute of Technology
Drottning Kristinas vag 51
S-100 44 Stockholm, Sweden

Phone:
Fax: 46-8-208284
Email:

“Estimates of Metal Release from the Technosphere to the Biosphere”

1998 GORDON RESEARCH CONFERENCE ON AQUEOUS CORROSION

Colby - Sawyer College -- New London, New Hampshire
July 5 - 10, 1998

J. Douglas Sinclair, Chair

Gerald S. Frankel, Vice Chair

CONFERENCE PROGRAM

Sunday, 7:30 PM - Corrosion Research Applied to Power Generation

Discussion leader: *Rudy Buchheit*, Ohio State University

- *Peter Andresen*
General Electric, *Mechanism of Stress Corrosion Cracking of Iron-Based Alloys.*
- *David Shoesmith*
AECL, Canada, *The Development of Containment Models for Environmental Performance Assessment in the Field of Nuclear Waste Disposal.*

10 POSTER PAPER PRESENTATIONS - 3 MINUTES EACH.

Monday, 8:45 AM - Fundamental Processes on Surfaces

Discussion leader: *Bill Smyrl*, University of Minnesota

- *Jerry Frankel*
Ohio State University, *Studies of Localized Corrosion by Scanning Kelvin Probe Force Microscopy and AFM Scratching.*
- *Karl Sieradzki*
Arizona State University, *Electrochemical Processing of Materials by Dealloying.*

10 POSTER PAPER PRESENTATIONS - 3 MINUTES EACH.

Monday, 7:30 PM - Corrosion/Reliability Prediction

Discussion leader: *Roger Staehle*, University of Minnesota

- *Ivan Cole*
CSIRO, Australia, *The Role of Surface Chemistry in the Atmospheric Corrosion of Zinc and Al-Zn Coatings: Progress Towards a Holistic Model.*
- *Jeffrey Braithwaite*
Sandia National Laboratory, *Physical Models for Predicting the Effect of Corrosion on Microelectronic Reliability.*

10 POSTER PAPER PRESENTATIONS - 3 MINUTES EACH.

Tuesday, 8:45 AM - Integrity/Structure of Passive Films

Discussion leader: *Brian Ives*, McMaster University

- *Sanna Virtanen*
Swiss Federal Institute of Technology, *Critical Factors in the Stability of Passive Films.*
- *J. Walter Schultze*
Heinrich-Heine-University, *Duesseldorf. Passivation and Corrosion of Microelectrode Arrays.*

10 POSTER PAPER PRESENTATIONS - 3 MINUTES EACH.

Tuesday, 7:30 PM - Corrosion Mechanisms and Prevention in Fluid Delivery Systems

Discussion leader: *Pat Moran*, U. S. Naval Academy

- *Mark Orazem*
University of Florida, *Applications of Electrochemical Impedance Spectroscopy for Flow-Enhanced Corrosion.*
- *Paul Jepsen*
Ohio University, *The Effect of Multiphase Flow on Sweet Corrosion in 3 Phase Oil/Water/Gas Pipeline Delivery Systems.*

Wednesday, 8:45 AM - Localized Corrosion

Discussion leader: *Tim Burstein*, University of Cambridge

- *Francois Huet*
University of Paris, *Electrochemical Noise Applied to Corrosion.*
- *Rob Kelly*
University of Virginia, *What Controls Crevice Corrosion Morphology.*

Wednesday, 7:30 PM - Reliability of Coatings/Protective Films for Corrosion Prevention

Discussion leader: *Paul Natishan*, Naval Research Laboratory

- ***Martin Stratmann***
Friedrich-Alexander-Universitaet Erlangen-Nuernberg, *Surface Modification by Ordered Monolayers: New Ways of Protecting Materials Against Corrosion.*
- ***Barbara Shaw***
Pennsylvania State University, *Amorphous Magnesium Alloy Films - What Makes Them Protective.*

Thursday, 8:45 AM - Corrosion Mechanisms and Prevention with Infrastructure Materials

Discussion leader: *Graham Wood*, University of Manchester Institute of Technology, Corrosion and Protection Centre

- ***John Scully***
University of Virginia, *Corrosion and Protection of Steel Pre-stressed Concrete Structures: Scientific Issues.*
- ***Christofer Leygraf***
Royal Institute of Technology, Sweden, *Estimates of Metal Release from the Technosphere to the Biosphere.*

Thursday, 7:30 PM - Corrosion Research Beyond the Year 2000

Moderator: *Ron Latanision*, Massachusetts Institute of Technology

Panelists:

- ***Koji Hashimoto***
Tohoku University
- ***Jerome Kruger***
Johns Hopkins University
- ***Alison Davenport***
University of Manchester, Materials Science Center
- ***Martin Kendig***
Rockwell International Science Center
- ***Roger Newman***
University of Manchester Institute of Technology, Corrosion and Protection Centre

Poster Session I - Monday, 4:30 PM - 6:00 PM (Posters on display from Sunday evening until noon Tuesday)

Sunday Evening Oral Presentations

1. **Inger Odnevall Wallinder**
Royal Institute of Technology, Sweden, *Corrosion of Copper Roofing - Impact Upon Environment.*
2. **Renate Lobnig**
Bell Laboratories, Lucent Technologies, *Atmospheric Corrosion of Copper in the Presence of Acid Ammonium Sulfate Particles.*
3. **Michael Unger**
University of Erlangen-Nuernberg, Germany, *The Influence of the Amount of Ammonium Sulfate Particles on the Atmospheric Corrosion Mechanism of Copper.*
4. **Guido Grundmeier**
University of Erlangen-Nuernberg, Germany, *New Insights into the Corrosion of Polymer Coated Steel.*
5. **Abi Olowe**
Western Michigan University, *Influence of Green Rusts in Corrosion.*
6. **Professor Ma Xinhua**
Tianjin Light Industry College, China, *The Corrosion in the Bittern Chemical Industry and the Choice of Materials.*
7. **Wendy Cieslak**
Sandia National Laboratory, *Building a Science-Based Computational/Experimental Approach to Predicting the Effects of Corrosion on Systems Reliability.*
8. **Aaron Neufeld**
CSIRO, Australia, *Tools for Understanding the Fundamentals of Atmospheric Corrosion.*
9. **Toshio Shibita**
Osaka University, Japan, *Effect of Anion Impurities on IGSCC of Sensitized Type 304 Stainless-Steel.*
10. **Uwe Konig**
Heinrich-Heine-University, Duesseldorf, *Time Resolved Depth Profiles Within Semiconductor Passive Layers.*

Monday Morning Oral Presentations

11. **Gautam Banerjee**
University of Notre Dame, *Corrosion Prevention of Aluminum without Chromate as an Inhibitor - A Novel Approach.*
12. **Minoru Fujita**
Musashi Institute of Technology, Japan, *Predicting Service Life of a Bright Ni-Cr Electroplating System on Steel.*
13. **Meryl Hall**
Bettis Atomic Power Laboratory, *Hydrogen Embrittlement Mechanism for Crack Advance in Primary Water Stress Corrosion Cracking of Nickel Base Alloys.*
14. **Glen Brown**
Keio University, Japan, *Towards Enhanced Understanding of Highly Localized Processes During Corrosion and Filming Behavior of Aluminum and Aluminum Alloys.*
15. **David Pratt**
Pennsylvania State University, *Selective Dissolution of Silver-Zinc Alloys.*
16. **Kerim Cetin**
Pennsylvania State University, *Galvanic Coupling Effects on Carbon Fiber Reinforced Polymer Materials Applied on Steel Reinforced Infrastructures.*

17. **Heather Williams**
Pennsylvania State University, *Intermetallic Powdered Metal Filters for Sulfur Removal in Fuels.*
18. **Mahmoud Abd Elhamid**
Pennsylvania State University, *The Effect of Some Additives on the Hydrogen Evolution and Absorption Reactions of Iron.*
19. **Takumi Haruna**
Osaka University, Japan, *Stress Corrosion Cracking of Heat Treated Mild Steel in Bicarbonate Solution.*
20. **Lisa DeJong**
University of Virginia, *The Use of Microfabrication Techniques for Crevice Corrosion Experiments.*

Additional Posters in Session I

21. **Madan Gopal**
Ohio University, *Stability of Corrosion Layers at High Pressure and Temperature Multiphase Flow.*
22. **Yasumasa Itoh**
Musashi Institute of Technology, Japan, *Statistical Approach to Image Processing of Corrosion of a Bright Ni-Cr Electroplated Steel.*
23. **Young Sik Kim**
Massachusetts Institute of Technology, *Synergistic Effect of W and Mo Addition on the Pitting Resistance of Super Ferritic Stainless Steels.*
24. **Kerry Allahar**
University of Florida, *Development of a Quasi-Potential Model for Corrosion under Disbonded Coatings.*
25. **Vimal Desai**
University of Central Florida, *Studies on Passivation Behavior of Tungsten in Application to Chemical Mechanical Polishing.*
26. **Andrei Marshakov**
Russian Academy of Sciences, *Kinetics of Iron Dissolution in Sulfuric Acid Electrolytes under Cathodic Polarization.*
27. **Karen Lewis**
University of Virginia, *Determination of Environmental Conditions Within Aircraft Lap-Splice Joints.*
28. **Andraz Legat**
Slovenian National Building and Civil Engineering Institute, *Characterization of Corrosion Processes by Measurements and Analysis of Electrochemical Noise.*
29. **Jason A. Cline**
Massachusetts Institute of Technology, *Experimental and Theoretical Investigations of Corrosion in Supercritical Water Oxidation Systems.*

Poster Session II - Tuesday, 4:30 PM - 6:00 PM (Posters on display from Tuesday afternoon until Thursday evening)

Monday Evening Oral Presentations

1. **Madan Gopal**
Ohio University, *Mechanistic Corrosion Studies Using EIS and ECN Techniques under Multiphase Flow Conditions in Large Diameter Pipes.*
2. **Luis Garfias**
University of Minnesota, *Novel Microvisualization of Localized Corrosion on Metals.*
3. **Maxim Petrunin**
Russian Academy of Sciences, *Corrosion of Aluminum and Iron in the Presence of Surface Organosilicon Nanolayers.*
4. **Merja Herranen**
Uppsala University, Sweden, *Scanning Force Microscopy and Quartz Crystal Gravimetry Applied to Corrosion Studies.*
5. **Bernard Covino**
U.S. DOE, Albany Research Center, *Environmental Interactions in Atmospheric Corrosion.*
6. **Kevin Cooper**
University of Virginia, *Chemical and Electrochemical Factors in the Environmental Assisted Cracking of an Al-Zn-Mg-Cu Alloy.*
7. **Eiji Akiyama**
Ohio State University, *A Study of Aluminum Artificial Crevice Electrodes.*
8. **Brian Connolly**
University of Virginia, *Localized Corrosion and Stress Corrosion Crack Initiation in Advanced Al-Li-Cu Alloys.*
9. **Raul Rebak**
Haynes International, *Localized Corrosion Resistance of HASTELLOY C-22, C-4 and C-276 Alloys as Candidate Materials for Nuclear Waste Repository: Effect of Alloy Aging at 427 C for up to 40,000 h.*

Tuesday Morning Oral Presentations

10. **Ludmila Maksaeva**
Russian Academy of Sciences, *Effect of Anionic Composition of Electrolyte on Hydrogen Permeation into Iron.*
11. **Patrick Schmutz**
Ohio State University, *A Combined In-situ Microgravimetric and XPS Study of the Passive Film Formed on Iron-Chromium Based Alloys.*
12. **Thodla Ramgopal**
Ohio State University, *Electrochemical Studies on High Strength Aluminum Alloys Susceptible to Exfoliation.*
13. **Andy Rudge**
Nuclear Electric, Ltd., United Kingdom, *Stress Corrosion Cracking in Once-Through Boilers: Research Supporting Boiler Lifetime Risk Assessment.*
14. **Jose R. Galvele**
Comision Nacional Energia Atomica, Argentina, *Effect of the Noble-Metal Cation on the SCC of Ag-Cd and CuZn Alloys.*
15. **Zhi Fang**
University of Minnesota, *Properties of Passive Films on High Nickel Alloys Exposed to Sulfur - Containing Environment.*

16. **Mohammed Al-Rifaie**
Pennsylvania State University, *The Use of EIS to Identify the Charge Carriers within a Passive Film.*
17. **Guenter Schmitt**
Iserlohn University, Germany, *New Concepts for Initiation and Migration of Flow Induced Localized Corrosion in Scale-Forming Corrosion Processes.*
18. **Hiroyuki Ogawa**
Kanazawa Institute of Technology, Japan, *The Application of the Extreme Statistics for the Prediction of HIC Nucleation.*
19. **Geetha Berera**
Massachusetts Institute of Technology, *Characterization of Passive Film Formed on Iron-Molybdenum Binary Alloys.*

Additional Posters in Session II

20. **Christopher Weyant**
University of Virginia, *An Investigation of the Mitigation of Atmospheric Corrosion by Surface Active Papers.*
21. **Kerry Allahar**
University of Florida, *Development of a Quasipotential Model for Corrosion under Disbonded Coatings.*
22. **Luca De Rosa**
University of Naples Federico II, Italy, *Corrosion Resistance of Bare and Coated 8006 and 8079 Aluminum Alloys in NaCl Aqueous Solution.*
23. **Anett Wuensche**
University Stuttgart, Germany, *Determination of Correlating Corrosion Processes at External and Internal Crack Environments.*
24. **Geoff Walter**
University of Wollongong, Australia, *Pitfalls in Polarization.*
25. **T. Sundararajan**
University of Madras, India, *Effect of Nitrogen Ion Implantation on the Passive Film and Corrosion Characteristics of Titanium Modified Type 316L Stainless Steel.*
26. **Daxi Wang**
University of Petroleum, China, *Quantum Chemical Calculation of Stabilization Energies on Imidazoline Derivatives.*
27. **Christian Lemaitre**
Universite de Technologie de Compiègne, France, *Conduction Mechanisms in the Passive Films Formed on Stainless Steels.*
28. **Bernd Wittek**
Pennsylvania State University, *In-Situ STM Study on the Surface Changes during Selective Dissolution of Copper-Gold Alloys below their Critical Potential.*
29. **Gary Leisk**
Massachusetts Institute of Technology, *Equipment Gerontology Study of an Aging Air Force Accelerometer.*
30. **Zhi Fang**
University of Minnesota, *Application of Potential Scanning to Assessing Possible SCC of High Nickel Alloys in Sulfur- and Chloride-Containing Environments; A New Correlation Parameter.*
31. **Young Sik Kim**
Massachusetts Institute of Technology, *Influences of Thermal Treatment on the Caustic Stress Corrosion Cracking of Super Austenitic Stainless Steel - S32050.*
32. **Lijun Gao**
Exxon Research and Engineering Company, *Electrochemical Impedance Spectroscopy Study of Corrosion by Organic Acids.*