16th International Symposium on Zirconium in the Nuclear Industry

Sponsored by ASTM Committee B10 on Reactive and Refractory Metals and Alloys

Symposium Chairman: Magnus Limbäck
Westinghouse Electric Sweden
Västerås
Sweden

Symposium Editorial Chairman: Pierre Barbéris
Areva/Cezus Research Center
Ugine
France

Symposium Co-Chairman: Wenjin Zhao
Nuclear Power Institute of China (NPIC)
Chengdu
China

SUNDAY, MAY 9, 2010

REGISTRATION 5:00PM – 7:00PM

MONDAY, MAY 10, 2010

8:15AM
Opening Remarks
Chengdu Governor 10 min
Luo Qi, NPIC President 10 min

8:35AM
M. Morel, Chairman, ASTM Committee B10 on Reactive and Refractory Metals and Alloys; M. Limbäck, Symposium Chairman; P. Barbéris, Symposium Editorial Chairman

Presentation of the John Schemel Award for the Best Paper from the 15th International Symposium
SESSION 1: BASIC METALLURGY

Session Chairs: B. Herb
ATI Wah Chang
Albany, OR, USA

J. Chakravartty
Bhabha Atomic Research Center
Mumbai, India

9:00AM
Dynamic Recrystallization in Zirconium Alloys
J.K. Chakravartty, R. Kapoor, A. Sarkar, and S. Banerjee, Bhabha Atomic Research Centre, Mumbai, India

9:30AM
Measurement and Modeling of Second Phase Precipitation Kinetics in Zirconium Alloys
J. Robson and M. Preuss, University of Manchester, Manchester, UK; and M. Ivermark, Westinghouse Electric Sweden, Västerås, Sweden

10:00AM
Effects of Tin and Niobium on Generalized-Stacking-Fault Energy Surface of Zirconium
Y. Udagawa, Japan Atomic Energy Agency and University of Tokyo, Tokai-mura, Naka-gun, Ibaraki, Japan; M. Yamaguchi, T. Tsuru, and T. Fuketa, Japan Atomic Energy Agency, Tokai-mura, Naka-gun, Ibaraki, Japan; H. Abe and N. Sekimura, University of Tokyo, Tokai-mura, Naka-gun, Ibaraki, Japan

10:30AM BREAK

11:00AM
Texture Evolution of Zircaloy-2 during Beta Quenching: Effect of Process Variables
J. Romero, University of Manchester, Manchester, UK and Westinghouse Electric Company, Pittsburgh, PA, USA; J. Quinta da Fonseca and M. Preuss, University of Manchester, Manchester, UK; M. Dahlbäck, and L. Hallstadius, Westinghouse Electric Sweden, Västerås, Sweden; R. Comstock, Westinghouse Electric Company, Pittsburgh, PA, USA

11:30AM
In Situ Study of Variant Selection During the α-β-α Phase Transformation in Zr-2.5Nb
P. Mosbrucker, M.R. Daymond, and R.A. Holt, Queen’s University, Kingston, ON, Canada

12:00AM
Development of Zr 2.5Nb Pressure Tubes for Advanced CANDU Reactor
G. Bickel, M. Griffiths, A. Douchant, S. Douglas, O. T. Woo, and A. Buyers, Atomic Energy of Canada Ltd., Chalk River, ON, Canada

12:30PM
SESSION 2: FABRICATION AND MECHANICAL PROPERTIES

Session Chairs:  
M. Preuss  
The University of Manchester  
Manchester, UK  

Y. Gaihuan  
State Nuclear Baoti Zirconium Co., Ltd  
China

2:00PM  
Microstructural Studies of Heat Treated Zr-2.5 Nb Alloy for Pressure Tube Applications  

2.30PM  
Segregation in Vacuum Arc Remelted Zirconium Alloy Ingots  
A. Jardy and M. Revil-Baudard, Institut Jean Lamour, Nancy, France; F. Leclerc, P. Guerin, and V. Rebeyrolle, AREVA/Cezus Research Centre, Ugine, France

3.00PM  
Damage Build-Up in Zirconium Alloys Mechanical Processing and Impacts on Quality of the Cold Pilgering Product  
A. Gaillac and P. Barberis, AREVA/Cezus Research Center, Ugine, France; C. Lemaignan, CEA/DEN DEC, Grenoble, France, and INPG SIMAP, St. Martin d'Hères, France

3:30PM  
BREAK

4:00PM  
Effect of Texture on the Anisotropic Thermal Creep of Pressurized Zr-2.5Nb Tubes  
W. Li and R.A. Holt, Queen’s University, Kingston, ON, Canada

4:30PM  
Creep of a Zr-2.5Nb Tube with Orientation and Temperature  
Y.S. Kim and S.S. Kim, Korea Atomic Energy Research Institute, Yusong, Daejon, Republic of Korea
Tuesday, May 11, 2010

5:00PM
**Micromechanical Approach of Visco-Plastic Behavior of Zircaloy-4 Recrystallized at 400°C**
M. Priser and P. Pilvin, LIMATB Université Bretagne-Sud, Lorient, France; M. Rautenberg and J.-M. Cloué, AREVA, Lyon, France; D. Poquillon, CIRIMAT, CNRS/UPA/INPT, Toulouse, France; X. Feaugas, Université de La Rochelle, Rochelle, France

5:30PM
Session Summary
Session Chairs

5:40PM Symposium Adjourns for the Day

**TUESDAY, MAY 11, 2010**

**SESSION 3: HYDRIDING – HYDROGEN EFFECT**

Session Chairs: P. Rudling
ANT International
Skultuna, Sweden

C. Coleman
AECL Chalk River Laboratories
Chalk River, ON, Canada

8:30AM
**The Effect of Microstructure on Delayed Hydride Cracking Behavior of Zircaloy-4 Fuel Cladding: an IAEA Coordinated Research Programme**
C. Coleman, AECL Chalk River Laboratories, Chalk River, ON, Canada; V. Grigoriev, Studsvik Nuclear AB, Nyköping, Sweden; V. Inozemtsev, IAEA, Vienna, Austria; V. Markelov, JSC VNIINM, Moscow, Russia; M. Roth, INR, Pitesti, Romania; V. Markarevicius, LEI, Kaunas, Lithuania; Y. S. Kim, KAERI, Daejeon, Korea; K. L. Ali, PINST, Islamabad, Pakistan; J.K. Chakravarty, BARC, Mumbai, India; R. Mizrahi, CNEA, Buenos Aires, Argentina; and R. Lalgudi, IPEN, Sao Paulo, Brazil

9:00AM
**High Temperature Aqueous Corrosion and Deuterium Uptake of Coupons Prepared from the Front and Back Ends of Zr-2.5Nb Pressure Tubes**
H. M. Nordin, A. J. Elliot, and S. G. Bergin, AECL, Chalk River, ON, Canada

9:30AM
**Hydrogen Absorption Mechanism of Zirconium Alloys Based on the Characterization of Oxide Layer**
K. Une, M. Aomi, K. Sakamoto, J. Matsunaga, Y. Etoh, Nippon Nuclear Fuel Development, Co., Ltd., Oarai-machi, Ibaraki-ken, Japan; I. Takagi, S. Miyamura, T. Kobayashi, Kyoto University, Yoshida, Sakyoku, Kyoto, Japan; and K. Ito, Global Nuclear Fuel Co., Ltd., Yokosuka-shi, Kanagawa-ken, Japan
10:00AM

In-situ SEM Observation and FEM Analysis of Delayed Hydride Cracking Propagation in Zircaloy-2 Fuel Cladding Tubes
T. Kubo, Nippon Nuclear Fuel Development Co., Ltd., Oarai-machi, Ibaraki, Japan; H. Muta and S. Yamanaka, Osaka University, Osaka, Japan; and M. Uno, Fukui University, Fukui-shi, Fukui, Japan; and K. Ogata, Japan Nuclear Energy Safety Organization, Minato-ku, Tokyo, Japan

10:30AM   BREAK

11:00AM

The Effect of Second Phase Particles on the Hydrogen Uptake Performance of Zirconium Alloys Corroded in Super-Heated Steam
M.Y. Yao, J.H Wang, B.X. Zhou, Q. Li, and J.L. Zhang, Shanghai University, Shanghai, China

11:30AM

In-Situ Study of Hydride Reorientation Kinetics Using Synchrotron Radiation
K. Colas and A. Motta, Penn State University, University Park, PA, USA; M. Daymond and M. Kerr, Queen’s University, Kingston, ON, Canada; and J. Almer, Argonne National Laboratory, Argonne, IL, USA

12:00AM

Statistical Analysis of Hydride Reorientation Properties in Irradiated Zircaloy-2
S. Valance and J. Bertsch, Paul Scherrer Institut, Villigen, Switzerland; and A.M. Alam, Alstom Power, Baden, Switzerland

12:30PM

Session Summary
Session Chairs

12:45PM   LUNCH

SESSION 4: CORROSION – OXIDE LAYER CHARACTERIZATION

Session Chairs:  R. Comstock
Westinghouse Research & Technology
Pittsburgh, PA, USA

T. Rui
NPIC
Chengdu, China
2:00PM  
**Detailed Microstructure of the Oxide-Metal Interface Region in Zircaloy-2 after Autoclave Testing**  

2:30PM  
**Study of the Initial Stage and Anisotropic Growth of Oxide Layers Formed on Zircaloy-4**  
B. X. Zhou, J. C. Peng, M. Y. Yao, Q. Li, S. Xia, C. X. Du, and G. Xu, Shanghai University, Shanghai, China

3:00PM  
**Towards a Mechanistic Understanding of Corrosion Mechanisms in Zirconium Alloys**  

3:30PM  
BREAK

4:00PM  
**Understanding Crack Formation at the Metal/Oxide Interface during Corrosion of Zirconium Alloys Using a Simple Mechanical Model**  
A. Ly, A. Ambard, M. Blat-Yrieix, and L. Legras, EDF Moret-sur-Loing, France; G. Parry and Y. Bréchet, INPG SIMAP, St. Martin d'Hères, France; P. Frankel and M. Preuss, University of Manchester, Manchester, UK; C. Curfs, ESRF, Grenoble, France

4:30PM  
**Corrosion of M5 in PWRs: Quantification of Li, B, H and Nb in the Oxide Layers Formed Under Different Conditions**  
P. Bossis, M. Tupin, C. Bisor-Melloul, C. Raepsaet, and H. Khodja, CEA Saclay, Gif-sur-Yvette, France; M. Blat and A. Ambard, EDF, Moret-sur-Loing, France; A. Miquet, EDF, Villeurbanne, France; and D. Kaczorowski, AREVA, Lyon, France

5:00PM  
**Advanced Zirconium Alloy for PWR Application**  
A. Garde, R. Baranwal, and G. Pan, Westinghouse Nuclear Fuel, Columbia, SC, USA; R. J. Comstock, Westinghouse Research & Technology Unit, Pittsburgh, PA USA; L. Hallstadius, Westinghouse Sweden, Västerås, Sweden; T. Cook, Western Zirconium, Ogden, UT, USA; and F. Carrera, Westinghouse Specialty Metals Plant, Blairsville, PA, USA

5:30PM  
Session Summary  
Session Chairs

5:40PM  
Symposium Adjourns for the Day
SESSION 5: IN PILE BEHAVIOUR

Session Chairs:  B. Cheng
EPRI
Palo Alto, CA, USA

L. Hallstadius
Westinghouse Sweden
Västerås, Sweden

9:00AM
Photoelectrochemical Investigation of Radiation Enhanced Shadow Corrosion Phenomenon
Y.-J. Kim and R. Rebak, GE Global Research Center, Schenectady, NY, USA; Y-P. Lin, D. Lutz, and D. Crawford, Global Nuclear Fuel – America, Wilmington, NC, USA; A. Kucuk and B. Cheng, Electric Power Research Institute, Palo Alto, CA, USA

9:30AM
Optimization of Zry-2 for High Burnups
F. Garzarolli, Erlangen, Germany; B. Cox, University of Toronto, Toronto, ON, Canada; and P. Rudling, ANT International, Skultuna, Sweden

10:00AM
Effects of Secondary Phase Particle Dissolution on the In-Reactor Performance of BWR Cladding

10:30AM    BREAK

11:00AM
Neutron Irradiated Zircaloy-4: Microstructural Changes Due Reactor Operating Conditions
11:30AM
**Ultra Low Tin Quaternary Alloys In-Pile Performance Impact of Tin Content on Corrosion and Mechanical Resistance**
V. Chabretou and J. J. Vermoyal, AREVA, Lyon, France; P.B. Hoffmann and S. Trapp-Pritsching, AREVA, Erlangen, Germany; G. Garner, AREVA, Lynchburg, VA, USA; P. Barberis and, V. Rebeyrolle, AREVA/CEZUS, Ugine, France

12:00
**Radiation Damage of E635 Alloy under High Dose Irradiation in the VVER-1000 and BOR-60 Reactors**
G. P. Kobylyansky, A. E. Novoselov, A. V. Obukhov, and Z. E. Ostrovsky, JSC SSC RIAR, Dimitrovgrad, Russia; V. N. Shishov, M. M. Peregud, and V.A. Markelov, JSC VNIIM, Moscow, Russia

12:30PM
Session Summary
Session Chairs

12:45PM  **KROLL AWARD LUNCHEON**

3:00PM  **POSTER SESSION**

See the poster list at the end of the program.
THURSDAY, MAY 13, 2010

SESSION 6: CREEP AND DEFORMATION

Session Chairs: M. McGrath
OECD
Halden, Norway

A. Motta
Penn State University
University Park, PA, USA

8:30AM
Simulation of Outside-in Cracking in BWR Fuel Cladding Tubes under Power Ramp
K. Sakamoto, M. Nakatsuka, and T. Higuchi, Nippon Nuclear Fuel Development, Co., Ltd.,
Higashi-Ibaraki, Ibaraki, Japan

9:00AM
Evaluation of Tensile Properties of Fuel Cladding Using Ring Tensile Specimens-An Assessment
K. S. Balakrishnan, R. S. Shrivastaw, B. N. Rath, E. Ramadasan, and S. Anantharaman, Bhabha Atomic Research Center, Trombay, Mumbai, India

9:30AM
Applicability of Miniature Specimen Techniques for Evaluating the Mechanical Properties of Zr-2.5% Nb Pressure Tube and Zr Alloy Fuel Cladding
B. N. Rath, R. S. Shriwastaw, K. S. Balakrishnan, R. V. Kulkarni, V. P. Jathar, E. Ramadasan, S. Anantharaman, and K. C. Sahoo, Bhabha Atomic Research Center, Trombay, Mumbai, India

10:00AM
Impact of the Irradiation Damage Recovery During Transportation on the Subsequent Room Temperature Tensile Behavior of Irradiated Zirconium Alloys
B. Bourdillau, F. Onimus, C. Cappelaere, and V. Pivetaud, CEA–Saclay, Gif-sur-Yvette, France; P. Bouffioux, EDF, Moret-sur-Loing, France; V. Chabretou, AREVA, Lyon, France; and A. Miquet, EDF/Septen, Villeurbanne, France

10:30AM BREAK

11:00AM
Effects of Pre-Irradiation on Irradiation Creep and Growth of Recrystallized Zircaloy-4
M. McGrath and H.K. Jenssen, IFE, Halden, Norway; and S. Yagnik, EPRI, Palo Alto, CA, USA
Thursday, May 13, 2010

11:30AM
**REFLET Experiment in OSIRIS: Relaxation under Flux for Creep Behavior of Assembly Components**
S. Carassou, P. Yvon, and F. Rozenblum, CEA Saclay, Gif-sur-Yvette, France; C. Duguay, CEA Cadarache, Saint Paul lez Durance, France; J.M. Cloué and V. Chabretou, AREVA NP, Lyon, France; C. Bernaudat, B. Levassuer, A. Maurice, EDF Septen, Villeurbanne, France; and P. Bouffioux and K. Audic, EDF, DRD/MMC, Moret-sur-Loing, France

12:00 AM
**Shadow Corrosion-Induced Bow of Zircaloy-2 Channels**
S. T. Mahmood, GE Vallecitos Nuclear Center, Sunol, CA, USA; P. E. Cantonwine, Y-P. Lin, D. C. Crawford, Global Nuclear Fuel, Wilmington, NC, USA; E. V. Mader, and K. Edsinger, Electric Power Research Institute, Palo Alto, CA, USA

12:30PM
Session Summary
Session Chairs

12:45PM LUNCH

**SESSION 7: FAILURE MECHANISMS AND TRANSIENTS**

Session Chairs: J. C. Brachet
CEA
Gif-sur-Yvette, France

S. Grigoriev
Studsvik Nuclear AB
Nykoping, Sweden

2:00PM
**The Issues of Oxygen Distribution in LOCA Situations**
C. Duriez, A. Stern, S. Guilbert, and C. Grandjean, IRSN, Saint-Paul lez Durance, France; and L. Bělovský, and J. Desquines, ALIAS CZ s.r.o., Praha, Czech republic

2:30PM
**Effect of Hydrogen on Mechanical Properties and Failure Morphology of LWR Fuel Cladding Tubes under Rapid Deformation**
M. Nakatsuka, Nippon Nuclear Fuel Development, Co., Ltd, Higashi-Ibaraki-gun, Ibaraki, Japan; and S. Yagnik, Electric Power Research Institute, Palo Alto, CA USA

3:00PM BREAK
3:30PM
The Iodine-induced Stress Corrosion Crack Behavior of Zr-Sn-Nb Alloy at Constant Strain Rate
X. Dai and W. Zhao, Nuclear Power Institute of China, Chengdu, China

4:00PM
RIA Failure of High Burn-up Fuel Rod Irradiated in KKL: Out-of-Pile Mechanical Simulation and Comparison with Pulse Reactor Tests

4:30PM
Session Summary
Session Chairs

4:40PM
Closing Remarks
M. Morel, Chairman, ASTM Committee B10 on Reactive and Refractory Metals and Alloys; M. Limbäck, Symposium Chairman; P. Barberis, Symposium Editorial Chairman

4:50PM
Announcement of Site for 17th Zr Symposium: A. Garde, B10 Symposium Sub Committee Chair and M. Martinez, B10-02 Sub Committee Chair

5:00PM The 16th International Symposium Adjourns

POSTERS

Critical Temperatures for Delayed Hydride Cracking in N18 Zirconium Alloy
C. Sun, J. Tan, S. Ying, Q. Peng, and S. Zhao, Nuclear Power Institute of China, Chengdu, Sichuan, China

ZIRLO Irradiation Creep
J. Foster and R. Baranwal, Westinghouse Electric Company, Columbia, SC, USA

Phase Transformations in Zr-Nb-Fe-Sn System Alloys
V.N. Shishov, JSC VNIIINM, Moscow, Russia

Secondary Hydriding Criteria under Irradiation Conditions
I.A. Evdokimov, V.V. Likhanskii, A.A. Sorokin, and V.D. Kanukova, State Research Centre of Russian Federation, Troitsk, Russia

High-temperature Oxidation Kinetics of E-110 Alloy Irradiated Claddings
A. Goryachev, J.J. Kosvintsev, and A.J. Leshchenko, JSC SCC RIRA, Dimitrovgrad, Russia

Investigation of the Interaction between Gliding Dislocations and Irradiation Induced Loops in Zirconium Alloys
F. Onimus and L. Dupuy, CEA-Saclay, Gif-sur-Yvette, France; and B. Doisneau-Cottignies, INPG, Grenoble, France

Nano-chemical Observations of Zirconium Alloy Corrosion using 3D Atom Probe

Effect of Elements on Corrosion Behavior of Zr Alloy in 500/10.3mpa Steam
J. Wang and J. Xiong, Sichuan University, Chengdu, China; Z. Miao, and S. Ying, Nuclear Power Institute of China, Chengdu, China

Fracture Toughness of a Cold-Worked Zr-2.5Nb Alloy with Temperature and Hydrogen Concentration
Y. S. Kim, D. W. Kim, and S. S. Kim, Korea Atomic Energy Research Institute, Yuseong, Daejeon, Korea

The High Temperature Oxidation Behaviors of N18 Zirconium Alloy
J. Qiu, X. Liu, and W. Zhao, Nuclear Power Institute of China, Chengdu, Sichuan, China

How to Obtain in Laboratory Representative Hydride Blisters on Zirconium Alloy: A Survey of Surface Effect
M. Blat-Yrieix, A. Ambard, and C. Watroba, EDF, Moret-sur-Loing, France; A. Miquet, EDF SEPTEN, Villeurbanne, France; A. Legris, CNRS, Villeneuve, d’Asq. France

SANS Analyses on Irradiated M5 and Zircaloy-4 Alloys after Annealing
J. L. Béchade, M. H. Mathon, D. Gilbon, CEA/Saclay, Gif-sur-Yvette, France; J. P. Mardon, AREVA, Lyon, France; A. Miquet, EDF, Moret-sur-Loing, France; and L. Legras, EDF/SEPTEN, Villeurbanne, France

Cladding Deformation Studies on Irradiated Fuel Pins from Indian PHWR
D. N. Sah, U. K. Viswanathan, S. Banerjee, P. Mishra, S. Kumar, and S. Anantharaman, Bhabha Atomic Research Center, Trombay, Mumbai, India

The Relationship of Matrix Microstructure, Oxide Film Characteristics and Corrosion Resistance of New Zirconium Alloys
H. Zhang, Z. Li, L. Zhou, Northwest Institute for Nonferrous Metal Research, Xi’an, China; D. Fruchart, E. K. Hill, and L. Ortega, Institut Néel, CNRS, Grenoble, France
An Experimental Study of Hydrides in Zirconium Alloys in View of Delayed Hydride Cracking
A. Steuwer, ESS Scandinavia, Lund, Sweden, and NMMU, Port Elizabeth, South Africa; M. Preuss and J. Romero, Manchester University, Manchester, U.K.; A.-M. Alvarez, Studsvik Nuclear AB, Nyköping, Sweden; and J. E. Daniels, European Synchrotron Radiation Facility, Grenoble, France

Influence of Hydrogen Content on Impact and Fracture Toughness of Zr-alloy Pressure Tubes used in Indian PHWRs
R. N. Singh, U. K. Viswanathan, J. S. Dubey, and J. K. Chakravartty, Bhabha Atomic Research Centre, Mumbai, Maharashtra, India

Optimization of the Zirconium Bars Manufacturing Using Numerical Simulation
K. Niang and J. L. Aubin, AREVA/Cezus, Paimboeuf, France; A. Gaillac, AREVA/Cezus, UGINE, France

Evaluation of Fracture Toughness and Critical Crack Length of Indian Pressure Tubes
K. S. Balakrishnan, P. K. Shah, J. S. Dubey, S. Anantharaman, and S. Chatterjee, Bhabha Atomic Research Centre, Trombay, Mumbai, India

High Temperature Oxidation Studies of Zirconium Based Alloys
H. K. Yueh, EPRI, Charlotte, NC, USA; Y. P. Lin, and D. Lutz, Global Nuclear Fuel, Wilmington, NC, USA

Modelling Irradiation Damage Evolution in CANDU Reactor Core Components
G. A. Bickel, S. R. Douglas, M. Griffiths, N. Wang, O. T. Woo, and A. W. Buyers, Atomic Energy of Canada, Chalk River, ON, Canada

The Effect of β-Quenching and Subsequent Ageing Treatments on the Corrosion Resistance of Zircaloy-4
M. Y. Yao, X. Zhang, S. L. Li, J. Q. Geng, J. H. Wang, B. X. Zhou, University of Shanghai, Shanghai, China; and W. J. Zhao, Nuclear Power Institute of China, Chengdu, Sichuan, China

Recrystallization Behavior of Cold-Rolled Zr-Sn-Nb-Fe Alloy Sheets
J. Chen, B. Luan, Q. Liu, X. Zhang, and T. Huang, Chongqing University, Chongqing, China

Effect of Hydrogen Contents on the Mechanical Properties of Zr-Sn-Nb Alloy
J. Zhou and L. Zhou, Northwest Institute for Nonferrous Metal Research, and Northwestern Polytechnical University, Xi’an, Shaanxi Province, China; and Z. Li and J. Zhang, Northwestern Institute for Nonferrous Metal Research, Xi’an, Shaanxi Province, China; B. Luan, Chongqing University, Chongqing, China

Fuel and Cladding Degradations Observed in PHWR Fuel Pins having Weld Defects
P. Mishra, U. K. Viswanathan, V. P. Jathar, J. L. Singh, D. N. Sah, and S. Anantharaman, Bhabha Atomic Research Center, Trombay, Mumbai, Maharashtra, India
Low Cycle Fatigue and Uniaxial Tensile Behavior of Thin-Walled Tubes of Zr-1Nb and Zircaloy-4 at Elevated Temperatures
Q. Jia, L.-X. Cai, C. Bao, and Y.-H. Cheng, Southwest Jiaotong University, Chengdu, Sichuan, China

Neutron Radiography - A Powerful Tool for Fast, Quantitative and Non Destructive Determination of the Hydrogen Concentration and Distribution in Zirconium Alloys
M. Grosse, Karlsruhe Institute of Technology, Germany

Validation of Weight Function Process-Zone Model for Flaw Evaluation against Delayed Hydride Cracking Initiation
S. X. Xu, and D. A. Scarth, Kinectrics Inc., Toronto, ON, Canada; and D. Kawa, Kedward, Kawa & Associates Ltd., Winnipeg, MB Canada

High Temperature Oxidation and Residual Ductility of Fuel Claddings from Zr-1Nb Alloy Having Different Contents of Impurities
V. Markelov, V.V. Novikov, A. V. Nikulina, A. G. Malgin, A. Y. Gusev, JSC VNIINM, Moscow, Russia; A. G. Ziganshin and E. N. Aktuganova, JSC, VTI, Glazov, Russia; V. E. Donnikov, V. I. Latunin, JSC VTI, Moscow, Russia; Y. V. Pimenov, JSC TVEL, Moscow, Russia

Mechanical Behavior and Damages within the Oxide Layer on Zy4 Cladding during a RIA
V. Busser, and J. Desquines, IRSN Saint-Paul lez Durance, France; M.-C. Baietto, Université de Lyon, Villeurbanne, France; C. Duriez, IRSN Saint-Paul lez Durance, France; J.-P. Mardon, Areva, Lyon, France; and D. Drouan, P. Lepesant, and A. Buiron, IRSN Saint-Paul lez Durance, France

Grain Stresses during Dissolution/precipitation of Hydrides in Zircaloy-4 plates
J. R. Santisteban, M. A. Vicente, CONICET and Instituto Balseiro, Centro Atomico Bariloche, Argentina; P. Vizcaino, A. D. Banchik, CNEA, Buenos Aires, Argentina; J. D. Almer, Argonne National Laboratory, Argonne, IL, USA

Texture Aspects of Technological Treatment of Zr-based Alloys
Y. Perlovich and M. Isaenkova, National Research Nuclear University, Moscow, Russia

Dependence of Orientation and Distribution of Hydrides on the Texture Inhomogeneity of Cladding Tubes from Zr Alloys
M. Isaenkova and Y. Perlovich, National Research Nuclear University, Moscow, Russia; and E. Aktuganova, V. Kotrekhou, and A. Zavodchikov, Chepetkiy Mechanical Plant, Glazov, Russia