

# Hydrogen Induced Cracking Analysis of a Pressure Vessel Made of SA 516 Grade 70 Steel by the Use of Phased Array Technology

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## 1. Abstract

Information regarding type, size, shape and location of the defects in objects can be obtained easily by the new generation of ultrasonic instruments which use Phased Array technology. This investigation studies the results of ultrasonic test with Phased Array technology done on a storage vessel and matches them with environmental conditions like corrosion to detect the type of the defects with 100% certainty. Inspections show that the detected cracks in the shell metal are originally formed by hydrogen induced cracking and calculations show that these cracks will not grow up if the hydrogen diffusion through the metal is stopped. Therefore, it is predicted that the operation of the pressure vessel in normal condition and under regular supervision can be continued if a suitable coating is applied to the interior of the vessel to prevent hydrogen diffusion.

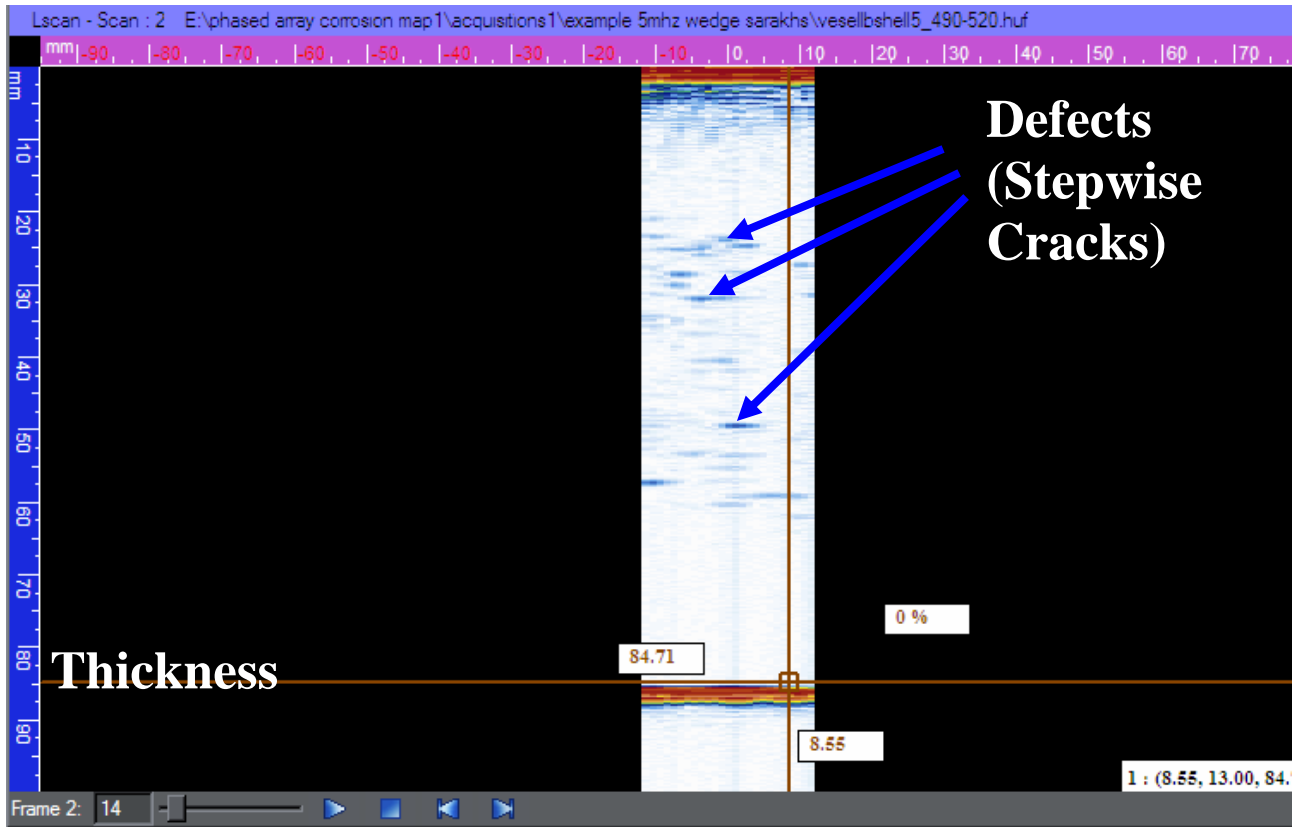
## 2. Conditions of Storage Vessel

The storage vessel is a horizontal pressure vessel which had been in service for more than 30 years. Sour water and condensate after separation from gas enter the vessel from top. These two substances will separate from each other in the vessel and water will drain from the bottom. Results of the ultrasonic test with Phased Array technology which is done on the external surface of the vessel shows many defects in the bottom of storage vessel which have been observed up to 24 mm from the external surface. Figure 1 shows these defects. The defects are at the bottom of the vessel and at the top which is not in continuous contact with sour water no defect is observed. This shows that these defects are related to the presence of sour water at the bottom portion of the vessel which is in continuous contact with sour water. These defects resemble hydrogen induced cracking since they are stepwise, narrow and elongated cracks. However the environmental conditions should be checked. Table (1) shows a brief description of the vessel.

**Table 1: Description of The pressure vessel**

<b>Material</b>	SA 516 Grade70
<b>Outer Radius</b>	994 mm
<b>Inner Radius</b>	915 mm
<b>Minimum Wall Thickness</b>	79 mm
<b>Working Pressure</b>	9.93 MPa
<b>Working Temperature</b>	60 °C
<b>Yield Point</b>	262 MPa

**Figure1: Linear Scan from Ultrasonic Test on the Storage Vessel with Phased Array Technology Showing Stepwise Cracks.**



### 3. Checking Environmental Conditions and Material Microstructure for Hydrogen Induced Cracking

There is a type of hydrogen damage called “Hydrogen Damage Due to Wet H<sub>2</sub>S (Sour Service)”.

Three factors are necessary for this type of damage to occur [1]:

1. A corrosion reaction that generates hydrogen atoms.
2. A chemical environment to enhance atomic hydrogen absorption into the steel (commonly sulfides).
3. A susceptible microstructure.

Investigations show that all of the above 3 factors are satisfied as follows for this pressure vessel. For this type of corrosion to occur the H<sub>2</sub>S concentration of the environment should be greater than 50 ppm. Chemical analysis of the sour water which is taken from the bottom of the pressure vessel shows that the concentration of the dissolved H<sub>2</sub>S in liquid phase is 14.5% (wt%) which is much more greater than 50 ppm. Hydrogen damage in wet H<sub>2</sub>S services is caused by the generation of atomic hydrogen as a byproduct of the corrosion reaction, and the subsequent diffusion of that atomic hydrogen into the steel. Atomic hydrogen is produced in many corrosive environments as in Equation (1):



Then two atoms subsequently combine to form a molecule of hydrogen gas as Equation (2):



However, certain compounds such as sulfide, cyanides (e.g. HCN), and arsenates, called recombination poisons or catalyst poisons, retard the conversion of atomic hydrogen to molecular hydrogen. In the presence of a catalyst poison, the surface concentration of atomic hydrogen rises, and a corresponding increase occurs in the amount of hydrogen diffusing into the metal.

In this vessel the concentration of H<sub>2</sub>S as the recombination poison as previously said is much greater than 50 ppm and since the vessel had been in service for more than 30 years then there was enough time for the diffusion of hydrogen. This elevated concentration of atomic hydrogen can affect the steel in several ways:

1. At laminations or inclusions, the hydrogen atoms may recombine to form molecular hydrogen; which is then too large to diffuse further through the steel and is trapped. If laminations are large enough, the internal hydrogen pressure may become sufficient to cause distortion and formation of a bulge on the surface (blistering).
2. The high concentration of atomic hydrogen can result directly in embrittlement and cracking of the steel, particularly high strength or high hardness steels. This often includes the heat affected zones in low strength steels that have not been PWHT (SSC).

3. A combination of the two effects may occur, wherein laminations on parallel planes are linked by cracks in the through-thickness direction (HIC).

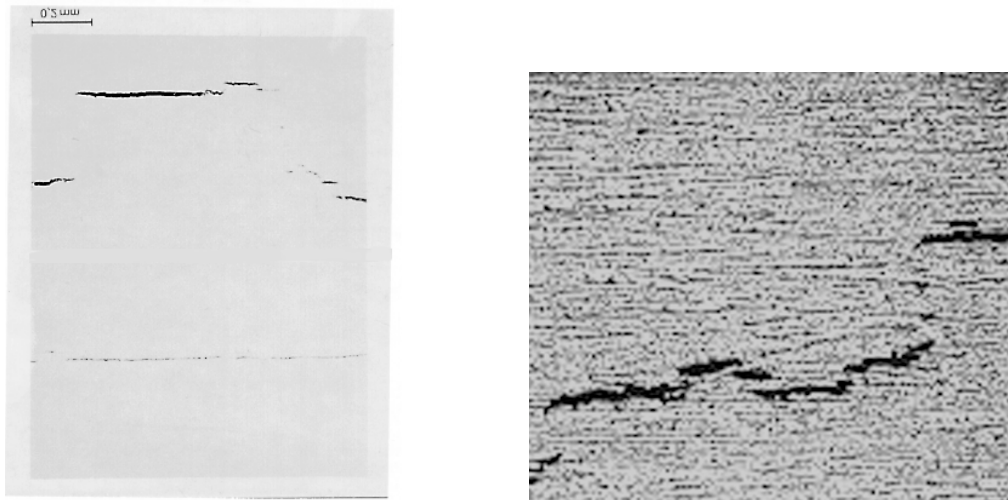
Some powder samples were taken from different parts of the pressure vessel, by grinding to evaluate the chemical analysis. Chemical composition of the vessel is analysed by atomic absorption method and the results are shown in Table (2).

**Table 2: Chemical Analysis of the Vessel (wt%)**

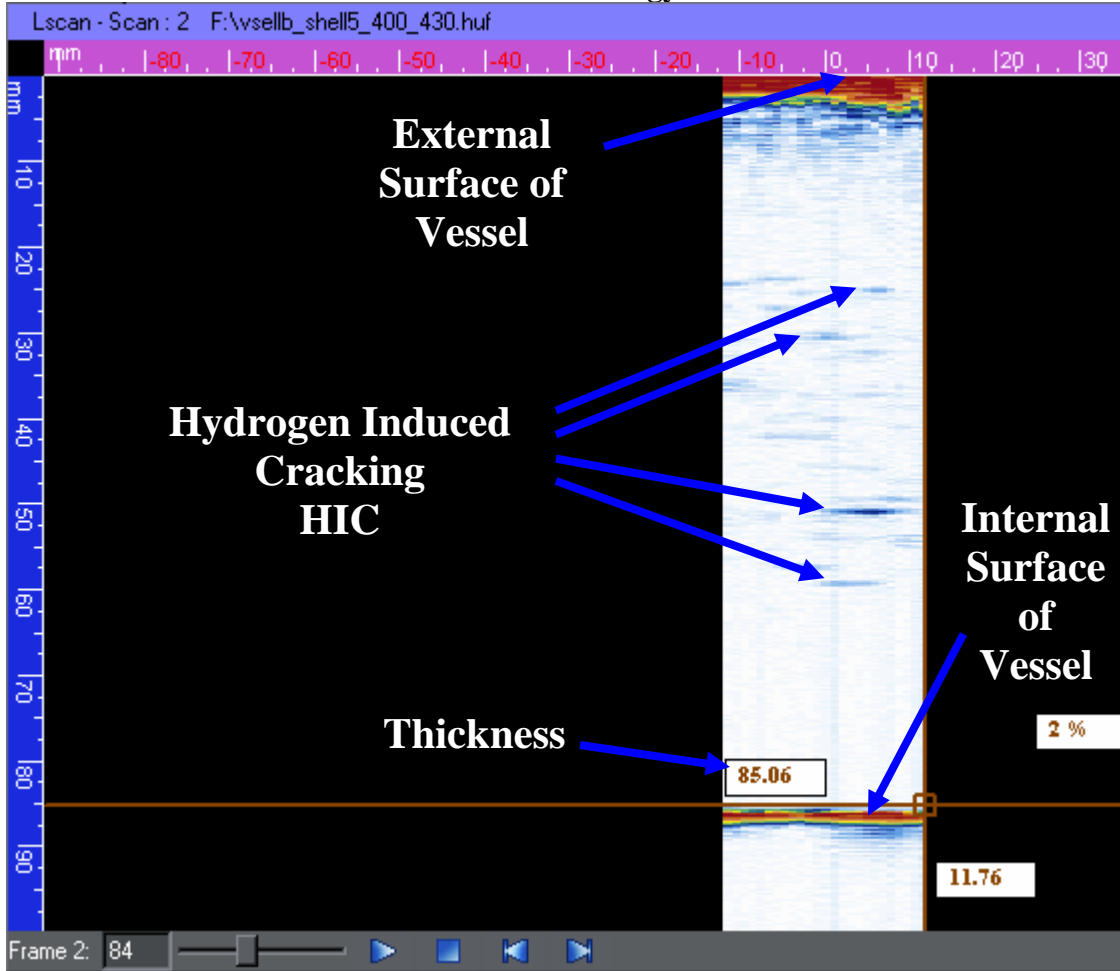
Element	%C	%Si	%Mn	%P	%S	%Cr,Ni,Mo,V
wt%	0.20	0.30	1.10	0.025	0.037	0

This table shows that there are two elements as manganese and sulphur in this alloy which form MnS during casting in steels. MnS in this alloy resides at grain boundaries. Atomic hydrogen after diffusion to the metal lattice resides at MnS. There, any two hydrogen atoms combine to form molecular hydrogen and will be trapped there [2]. Hydrogen Induced Cracking (HIC) which is produced due to internal hydrogen pressure in metallurgical defects has happened in this storage vessel. These cracks are elongated and narrow and this is the thing observed in Linear Scan of the vessel. In Figure (2) samples of HIC are shown to compare with Figures (1) and (3) which are Linear Scan view of the cracks observed in the vessel. Compare show that cracks in Figures (1) and (3) are similar to HIC cracks and are stepwise.

**Figure 2: Samples of HIC in Steel**

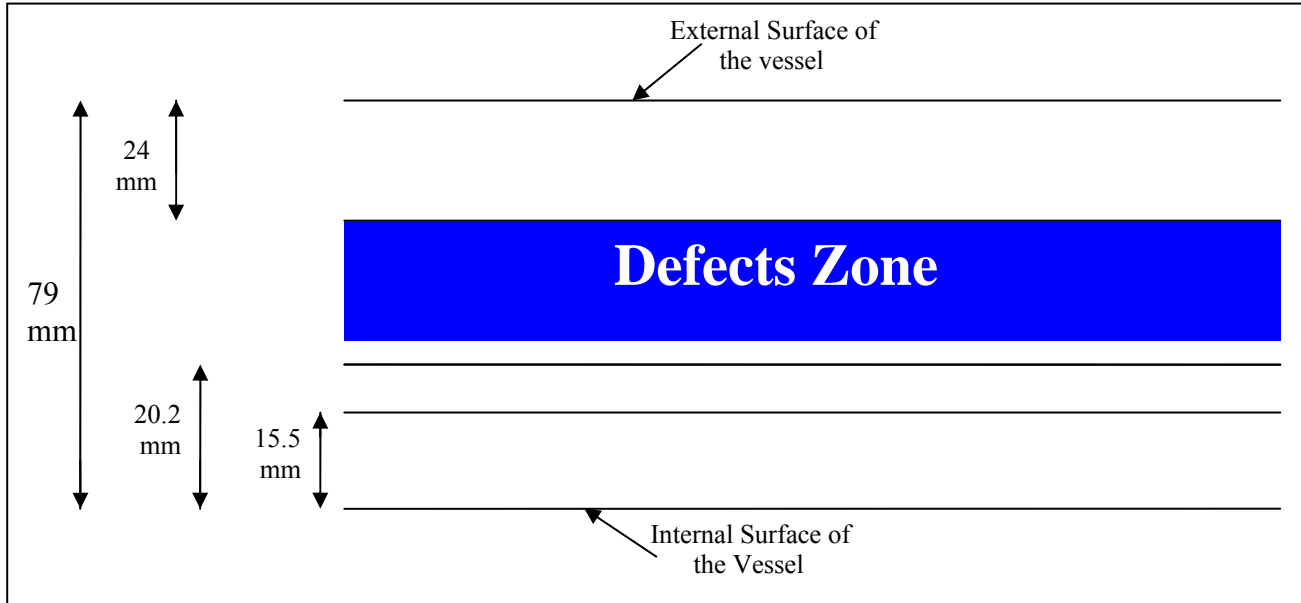


**Figure 3: Actual Picture of HIC in the Pressure Vessel Using Phased Array Technology.**



By analogy Figure (3) shows that cracks are stepwise like figure (2). By increasing size and frequency of the cracks the possibility of forming HIC or stepwise cracks increases. This goes on by continuing hydrogen diffusion and finally causes failure of the shell. There fore hydrogen diffusion must be stopped. These HICs do not lie in the zone of minimum thickness. Except some limited points which are not connected. So according to standard API 510 [3] these cracks are within the safe region. Also another 24 mm layer exists which increases pressure retaining ability of the material. Figure (4) shows limited zone of the observed defects in the shell of the vessel in blue. This figure is based on the results of ultrasonic test with phased array technology.

**Figure 4: The Limited Zone of Detected Defects**



Hydrogen damage is mentioned as one of the deterioration modes which commonly occurs in pressure vessels in standard API 510 [3].

#### **4. Is It Safe To Operate Under Normal Conditions If Hydrogen Diffusion Is Stopped?**

To answer this question we use fracture mechanics. In fracture mechanics a crack will result in failure when stress intensity factor becomes greater than fracture toughness ( $K_{IC}$ ) of the material [4]. Equation (3) gives stress intensity factor for the crack of Figure (5) [5]. Figure (5) shows the parameters of this equation.

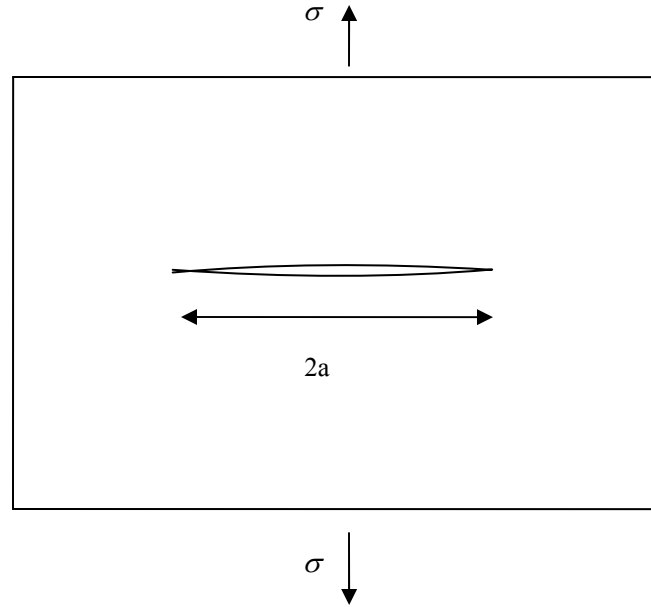
$$K = \sigma\sqrt{\pi a} \quad (3)$$

$K$  = Stress Intensity Factor,  $\text{MPa}\sqrt{m}$

$\sigma$  = Applied Stress, MPa

$a$  = Crack Size, m

**Figure 5: Fracture Parameters**



We obtained the length of the longest crack to be 20 mm ( $2a = 20\text{mm}$ ). Based on the shape and position of the detected crack, the hoop stress is the most important component of the applied stress which can develop the crack. This stress can be calculated by the following Equation (4).

$$\sigma = \frac{p}{K_1^2 - 1} \left( 1 + \frac{r_o^2}{r_i^2} \right), \quad K_1 = \frac{r_o}{r_i} \quad (4)$$

Where  $\sigma$  is the hoop stress, P is the internal pressure;  $r_o$  and  $r_i$  are outside and inside radii respectively. So

$$K_1 = 1.09, \quad \sigma = \frac{9.93}{1.09^2 - 1} \left( 1 + \frac{994^2}{915^2} \right) = 114 \text{ MPa.}$$

There fore from equation 5 we have:

$$K = 114 \sqrt{\pi \times 0.01} = 20 \text{ MPa} \sqrt{m}$$

Fracture toughness ( $K_{IC}$ ) is a property of the material and is specific to each material. The value of fracture toughness for the steel applied in the storage vessel is equal to  $78.2 \text{ MPa} \sqrt{m}$  [7]. Comparing the value of  $K_{IC}$  with K shows that K is lower than  $K_{IC}$ . Therefore the crack would not grow under normal operating conditions supposed that hydrogen diffusion is stopped. The reason why these

cracks happened is the existence of hydrogen and corrosive environment which reduces  $K_{IC}$ .

## **5. Conclusion and Remedial Actions**

In possible methods for control of hydrogen damage, if corrosion of steel is stopped, no hydrogen atom will produce. Therefore hydrogen will not diffuse in to the metal and the cracks will not extend and will not link together. The best way to prevent hydrogen damage in this case is the use of nonmetallic coatings which are highly applicable, cheap and easy to install. Other methods such as coating with cladding and thermal spray are not advised. Since the pressure vessel has been built and it is impossible for cladding to be done on the internal surface and thermal spray is not good because it is very difficult to bring the necessary equipments inside the pressure vessel. After applying a suitable coating under regular supervision the pressure vessel can operate in normal operating condition.

## **6. Acknowledgements**

The authors thank Engineer M. R. Naghibi the president of East Oil and Gas Production Company for making this research effort possible and Engineer J. Mostowfi for his technical support.



## **7. References**

- [1] Chevron Research and Technology Company, "CORROSION PREVENTION MANUAL", Richmond, CA, December 1997.
- [2] Farzam, Mansour "Hydrogen degradation of steel, diffusion and deterioration" Iranian Journal of Science and Technology, Vol.28, No.B2, 2004, P255.
- [3] API 510 Standard " PRESSURE VESSEL INSPECTION CODE: MAINTENANCE INSPECTION, RATING, REPAIR, AND ALTERATION", EIGHT EDITIONS, 2001.
- [4] Avallone, Eugene A. and Baumeister, Theodore "MARKS' STANDARD HANDBOOK FOR MECHANICAL ENGINEERS" Tenth Edition, McGraw Hill, New York, 1996.
- [5] Farzam, Mansour "CORROSION ENGINEERING AND PROTECTION OF METALS" 1<sup>st</sup> Edition, Yadvareh Ketab Publications, Tehran 1999.
- [6] Anderson, TL. "FRACTURE MECHANICS: FUNDAMENTAL AND APPLICATION" 2nd ed., 1955, p.55–63.
- [7] Ashby, Michael F. and Jones, David R. H. "ENGINEERING MATERIALS 1, AN INTRODUCTION TO THEIR PROPERTIES AND APPLICATIONS" Second Edition, Department of Engineering, University of Cambridge, UK,1996.

July 17, 2009

Le 17 juillet 2009

This is to certify that

La présente atteste que

*Mansour Farzam*

Petroleum University of Technology  
AHWAZ, IRAN

has attended the  
12<sup>th</sup> International Conference on Fracture  
held in Ottawa, Canada  
from July 12 to 17, 2009

a assisté à la  
12<sup>e</sup> Conférence internationale sur la rupture  
tenue à Ottawa, Canada  
du 12 au 17 juillet 2009

and presented the following paper:

et a présenté la communication suivante :

**Hydrogen Induced Cracking Analysis of a Pressure Vessel Made of SA 516 Grade 70 Steel  
by the Use of Phased Array Technology**

M. Farzam\*, P. Malekinejad, M. Khorashadizadeh  
*Petroleum University of Technology, Ahwaz, Iran*

*Nicole A. Sarault*

Nicole A. Sarault  
Conference Manager / Gestionnaire de conférence

**T01-S1****Monday July 13, 10:30 – 12:10**

Westin Hotel - Quebec Room

Chair: J. Beddoes, *Carleton University, Canada*

- 10:30 T01.004 **Keynote Presentation**  
**The UniGrow Fatigue Crack Growth Model for Spectrum Loading**  
S. Mikheevskiy\*, G. Glinka  
*University of Waterloo, Waterloo, Canada*
- 11:10 T01.005 **Time Dependent Fracture Mechanics Considerations in Titanium 6Al-2Sn-4Zr-6Mo at Elevated Temperatures**  
D.E. Mills\*, T.S. Cook  
*Rolls-Royce Corporation, Indianapolis, USA*
- 11:30 T01.010 **Development and Validation of Fatigue Crack Growth and Lifting Methodologies Through Comprehensive Coupon and Component Testing Under Spectrum Loading Representative of P-3C Maritime Surveillance Aircraft**  
K. Walker\*, E. Matricciani, W. Hu, J. Duthie  
*DSTO, Melbourne, Australia*
- 11:50 T01.003 **Fibre-Metal Laminates and Variable-Amplitude Loading**  
S.U. Khan\*, R.C. Alderliesten, J. Schijve, R. Benedictus  
*Technical University of Delft, Delft, The Netherlands*

**T01-S2****Monday July 13, 15:30 – 17:30**

Westin Hotel - Quebec Room

Chair: Kevin Walker, *DSTO, Australia*

- 15:30 T01.012 **Keynote Presentation**  
**A Physics-Based Understanding of Hold-Time Effects on Fatigue**  
X.J. Wu\*  
*National Research Council Canada, Ottawa, Canada*
- 16:10 T01.007 **Crack Growth in Mil Annealed Ti-6AL-4V Structural Components**  
S. Pitt\*, R. Jones, B. Farahmand  
*Monash University, Victoria, Australia*
- 16:30 T01.001 **The Fatigue Characteristics of Friction Stir Welded Stiffened Panel Structure**  
R. Bell\*, H. Jung, X. Wang  
*Carleton University, Ottawa, Canada*
- 16:50 T01.008 **Damage of Protective Coating Due to Unstable Engine Running**  
S. Pospíšilová\*, M. Kianicová, M. Záhoran  
*Alexander Dubcek University In Trencin, Slovakia*
- 17:10 T25.010 **Experimental Study of Portevin-Le Châtelier plastic instabilities by infrared pyrometry-Type A to Type B Transition**  
D. Wagner\*, N. Ranc  
*LEME, University Paris X, Ville d'Avray, France*

**T01-S3****Tuesday July 14, 10:30 – 12:10**

Westin Hotel - Quebec Room

Chair: S. Mikeevskiy, *University of Waterloo, Canada*

- 10:30 T01.002 **Fracture Mechanics Modelling of Multiple Site Damage Scenarios**  
Y. Bombardier\*, M. Liao, G. Renaud  
*National Research Council Canada, Ottawa, Canada*
- 10:50 T01.006 **Through-Life Assessment of Ductile Tearing under Low-Constraint Conditions**  
V.P. Naumenko\*  
*G.S. Pisarenko Institute for Problems Of Strength, Kyiv, Ukraine*
- 11:10 T01.009 **Simulation of Discrete-source Damage Propagation and Residual Strength of Aircraft Structures**  
A.D. Spear\*, J.D. Hochhalter, A.R. Ingraffea  
*Cornell Fracture Group, Cornell University, Ithaca, USA*
- 11:30 T01.011 **Advances in Simulation of Arbitrary 3D Crack Growth using FRANC3D/NG**  
P.A. Wawrzynek\*, B.J. Carter, A.R. Ingraffea  
*Fracture Analysis Consultants, Inc., Ithaca, USA*
- 11:50 T23.001 **Experimental Verification of Structural Integrity for Bellows as Spacecraft Components**  
S. Kébreau\*, P. Cambrésy  
*EADS Astrium, Bremen, Germany*

**T02-S1****Wednesday July 15, 13:30 – 15:10**

Westin Hotel - Les Saisons Room

Chair: Gregory Glinka. *University of Waterloo, Canada*

- 13:30 T02.018 **Keynote Presentation**  
**About Accumulation Rules for Life Time Prediction under Variable Loading**  
S.E. Mikhailov\*, I.V. Namestnikova  
*Brunel University West London, Uxbridge, UK*
- 14:10 T02.002 **Prediction of Fracture Energy of IN738LC Superalloy using Neural Network**  
N. Bano\*, A. Fahim, M. Nganbe  
*University of Ottawa, Ottawa, Canada*
- 14:30 T02.003 **Probabilistic Simulation for Nanocomposite Fracture**  
C.C. Chamis\*  
*NASA Glenn Research Center, Cleveland, USA*
- 14:50 T02.004 **Procedure to Estimate the Crack Resistance Curve from the Instrumented Charpy Impact Test**  
R. Chaouadi\*, J.-L. Puzzolante  
*SCK-CEN, Mol, Belgium*

**T02-S2****Wednesday July 15, 15:30 – 17:10**

Westin Hotel – Les Saisons Room

Chair: S.E. Mikhailov, *Brunel University, UK*

- 15:30 T02.006 **Elastic Analysis of Sinusoidal Cracks**  
K. Fujimoto\*  
*University Of Tokyo, Japan*
- 15:50 T02.007 **Boundary Value Problems Posed in Terms of Stress Orientations for Plane Crack Systems**  
A.N. Galybin\*  
*Wessex Institute Of Technology, Southampton, UK*
- 16:10 T02.008 **Leading Edge of a Hydraulic Fracture Crossing a Stress Boundary**  
D.I. Garagash\*, A. Rohde, A.P. Bungler  
*Dalhousie University, Halifax, Canada*
- 16:30 T02.009 **Potential Energy of Two Collinear Cracks**  
B.Y. Gommerstadt\*  
*Northeastern University, Boston, USA*
- 16:50 T02.010 **Modeling of Fatigue Wear of a Layered Elastic Foundation in Contact with Periodic System of Dies**  
E.V. Torskaya\*, I.V. Goryacheva  
*Institute For Problems In Mechanics RAS, Moscow, Russia*

**T02-S3****Thursday July 16, 10:30 – 12:10**

Westin Hotel - Les Saisons Room

Chair: Digby Macdonald, *Pennsylvania State University, USA*

- 10:30 T02.011 **Improvement of Slice Synthesis Methodology to Estimate Stress Intensity Factor of an Embedded Crack in Finite body**  
K. Gotoh\*, Y. Nagata  
*Kyushu University, Fukuoka, Japan*
- 10:50 T02.012 **Crack Growth in D6ac Steel Structural Components**  
R. Jones\*, S.C. Forth  
*Monash University, Victoria, Australia*
- 11:10 T02.013 **Crack Theory with Possible Contact between the Crack Faces**  
A.M. Khludnev\*  
*Lavrentyev Institute of Hydrodynamics, Novosibirsk, Russia*
- 11:30 T02.014 **Unified Representation and Evaluation of the Strength Hypotheses**  
V.A. Kolupaev\*, A. Bolchoun, H. Altenbach  
*German Institute for Polymers(DKI), Darmstadt, Germany*
- 11:50 T02.015 **Pre-Fracture Zone for the Antiplane Shear Crack in Structured Material**  
V.M. Kornev\*  
*Lavrentyev Institute of Hydrodynamics SB RAS, Novosibirsk, Russia*

**T02-S4****Thursday July 16, 13:30 – 15:10**

Westin Hotel - Les Saisons Room

Chair: Rhys Jones, *Monash University, Australia*

- 13:30 T02.016 **Unification of the Theories for Stress Corrosion Cracking and Corrosion Fatigue**  
D.D. Macdonald\*, G.R. Engelhardt  
*Pennsylvania State University, University Park, USA*
- 13:50 T02.017 **Contact Interaction of Interlaminar Crack Faces under Harmonic Loading**  
O.V. Menshykov\*, I.A. Guz  
*University Of Aberdeen, Aberdeen, Scotland, UK*
- 14:10 T02.001 **Stress Intensity Factors and the Weight Function for an Elliptical Crack**  
E. Atroshchenko\*, G. Glinka, S. Potapenko  
*University Of Waterloo, Waterloo, Canada*
- 14:30 T02.020 **Fatigue Crack Propagation in Plain Concrete Using Incomplete Self-similarity**  
S. Ray\*, J.M. Chandra Kishen  
*Indian Institute Of Science, Bangalore, India*
- 14:50 T02.029 **Cyclic Elasto-Plastic Fracture Diagram for a Specimen with Crack**  
S. Sherbakov\*, A.V. Bogdanovich, L.A. Sosnovskiy  
*S & P Group TRIBO-FATIGUE, Gomel, Belarus*

**T02-S5****Thursday July 16, 15:30 – 17:10**

Westin Hotel - Les Saisons Room

Chair: E.V. Torskaya, *Institute For Problems In Mechanics, RAS, Russia*

- 15:30 T02.021 **Optimal Extraction of Fracture Parameters from Kinematic Fields**  
S. Roux\*, J. Réthoré, F. Hild  
*LMT Cachan, Cachan, France*
- 15:50 T02.022 **Is the Edge Crack the Most Dangerous V-notch?**  
A. Sapora\*, A. Carpinteri, P. Cornetti, N. Pugno  
*Politecnico Di Torino, Turin, Italy*
- 16:10 T02.026 **Prediction of Ductile Fracture Toughness**  
J.-S. Wang\*, G.B. Olson  
*QuesTek Innovations LLC, Evanston, USA*
- 16:30 T02.024 **Interaction of a Griffith Crack in a Three-Phase Circular Inclusion with two Imperfect Interfaces**  
L.J. Sudak\*, P.G. Park  
*University of Calgary, Canada*
- 16:50 T02.028 **Plastic Notch Stress Intensity Factors and Strain Energy Density for Pointed V-Notches under Torsion**  
M. Zappalorto\*, P. Lazzarin  
*University Of Padova, Italy*

**T03-S1****Wednesday July 15, 10:30 – 12:10**

Conference Centre - Sussex Lounge

Chair: D. Rodney, *SIMAP-GPM2, Grenoble Institute of Technology, France*

- 10:30 T03.017 **Keynote Presentation**  
**Atomic-Scale Deformation Kinematics for Bicrystal Grain Boundaries under Shear Loading**  
G.J. Tucker\*, D.L. McDowell, J.A. Zimmerman  
*Georgia Institute of Technology, Atlanta, USA*
- 11:10 T03.005 **Fracture Toughness of Polycrystalline Tungsten Alloys**  
B. Gludovatz\*, S. Wurster, A. Hoffmann, R. Pippan  
*Erich Schmid Institute Of Materials Science, Austrian Academy Of Sciences, Leoben, Austria*
- 11:30 T03.014 **Keynote Presentation**  
**Molecule Mechanics Simulation on the Deformation and Damage Process in POSS Nanocomposite**  
Y. Sun\*, J. Li, F.L. Zeng  
*Harbin Institute Of Technology, Harbin, China*

**T03-S2****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Sussex Lounge

Chair: R.E. Miller, *Carleton University, Canada*

- 13:30 T03.006 **A Framework for Continuum-Atomistic Simulations of Crack Tip Plasticity**  
R. Gracie\*, T. Belytschko  
*Northwestern University, Evanston, USA*
- 13:50 T03.022 **3D Thermo-Mechanical Multiscale Coupling**  
G. Ancaux\*, J.-F. Molinari  
*Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*
- 14:10 T03.023 **Multiscale Modeling of Fatigue Crack Initiation and Propagation in Nanocrystalline Metals**  
B. Shiari\*, R.E. Miller  
*Carleton University, Ottawa, Canada*
- 14:30 T03.007 **A Method for Combining Experimentation and Molecular Dynamics Simulation to Improve Cohesive Zone Models for Metallic Microstructures**  
J.D. Hochhalter\*, E.H. Glaessgen, A.R. Ingraffea, W.A. Aquino  
*Cornell University, Ithaca, USA*
- 14:50 T03.019 **Molecular Dynamics-Derived Cohesive Zone Law for Interfacial Fracture as a Function of Loading Mixture and Elastic Constants for Bilayer Materials**  
X.W. Zhou\*, N.R. Moody, R.E. Jones, J.A. Zimmerman, E.D. Reedy  
*Mechanics of Materials Department, Sandia National Laboratories, Livermore, USA*



**T03-S3****Wednesday July 15, 15:30 – 17:30**

Conference Centre - Sussex Lounge

Chair: R. Gracie, *Northwestern University, USA*

- 15:30 T03.010 **Keynote Presentation**  
**Size-Dependent Plasticity in Twinned Metal Nanowires**  
F. Sansoz\*, C. Deng  
*University Of Vermont, Burlington, USA*
- 16:10 T03.024 **Effects of Temperature and Grain Size on the Properties of Copper Nanotwinned Structures**  
I. Shabib\*, R.E. Miller  
*Carleton University, Ottawa, Canada*
- 16:30 T03.013 **Atomic Mechanisms of Structural Reconstruction of FCC-Metals in the Process of Tension Deformation**  
M.D. Starostenkov\*, A.V. Yashin, N.V. Sinitca, E.A. Dudnik  
*Altay State Technical University*
- 16:50 T03.027 **Keynote Presentation**  
**Thermally-Activated Plasticity at the Atomic Scale**  
D. Rodney\*  
*SIMAP-GPM2, Grenoble Institute of Technology, Saint Martin d'Hères, France*

**T03-S4****Thursday July 16, 10:30 – 11:50**

Conference Centre - Sussex Lounge

Chair: F. Sansoz, *University Of Vermont, USA*

- 10:30 T03.015 **Constraining Dislocation Movement in Molecular Dynamics: Application to Crack-Dislocation Interactions**  
D. Tanguy\*  
*CNRS, UMR 5146, Saint-Etienne, France*
- 10:50 T03.001 **A Theoretical Description of the Structure of the Nonlinear Zone in the Vicinity of the Tip of a Dynamic Mode I Crack**  
E. Bouchbinder\*, A. Livne, J. Fineberg  
*Racah Institute Of Physics, The Hebrew University of Jerusalem, Jerusalem, Israel*
- 11:10 T03.025 **Local and Global Instabilities in Fracture of Brittle Crystals under Combined Tensile and Shear Stresses**  
D. Sherman\*, O. Barkai  
*Technion, Haifa, Israel*
- 11:30 T03.026 **The Role of Phonon Emission in Dynamic Crack Propagation in Brittle Single Crystals**  
F. Atrash\*, A. Gleizer, D. Sherman  
*Technion, Haifa, Israel*

**T03-S5****Thursday July 16, 13:30 – 14:50**

Conference Centre - Sussex Lounge

Chair: G. Anciaux, *Ecole Polytechnique Fédérale de Lausanne, Switzerland*

- 13:30 T03.028 **Temperature Dependence of Crack-Tip Partial Dislocation Nucleation in FCC Metals**  
D.H. Warner\*, W.A. Curtin  
*Cornell University, Ithaca, USA*
- 13:50 T03.016 **Atomistic Simulations of Dislocation Nucleation**  
M.A. Tschopp\*, D.L. McDowell  
*Air Force Research Laboratory, Wright-Patterson Air Force Base, OH, USA*
- 14:30 T03.029 **Grain Boundary Motion Assisted via Displacement Cascades in bcc Fe**  
R.E. Miller\*, K.P. Boyle, C. Campana  
*CANMET-MTL, Natural Resources Canada, Ottawa, Canada*

**T03-S6****Thursday July 16, 15:30 – 16:50**

Conference Centre - Sussex Lounge

Chair: M.A. Tschopp, *Air Force Research Laboratory, Wright-Patterson Air Force Base, USA*

- 15:30 T03.030 **Thermal Conductivity of the Damaged Gold Nanowires**  
K. Pochiraju\*, N. Kumar  
*Design and Manufacturing Institute*
- 15:50 T03.008 **Fracture between Self-Assembled Monolayers**  
K.M. Liechti\*, M. Wakamatsu, B. Doynov, M.Y. Ngai, M.J. Krische  
*University Of Texas at Austin, USA*
- 16:10 T03.002 **Elasticity and Strength of Nano-Fiber Reinforced Composites from First Principles**  
M. Cerny\*, J. Pokluda  
*Brno University of Technology, Brno, Czech Republic*
- 16:30 T03.003 **Dynamic Fragmentation of Single-Wall Carbon Nanotubes Induced by Sonication**  
H.B. Chew\*, K.-S. Kim  
*Brown University, Providence, Rhode Island, USA*

**T04-S1****Monday July 13, 10:30 – 12:10**

Conference Centre - Rideau Room

Chair: N. Miyazaki, *Kyoto University Japan*

- 10:30 T04.012 **Relationships Among Microstructural Features and Crack Propagation in Osteonal Bone Identified Using Finite Element Analysis**  
E.K. Oneida\*, M.C.H. van der Meulen, A.R. Ingraffea  
*Cornell University, Ithaca, USA*
- 11:10 T04.015 **Strategies Combining Cells and Scaffolds for Bone Tissue Engineering**  
E. Saino\*, L. Fassina, V. Maliardi, M.S. Sbarra, M.G. Cusella De Angelis, G. Magenes, F. Benazzo, L. Visai  
*University of Pavia, Pavia, Italy*
- 10:50 T04.014 **Fracture Toughness of Carbon Nanotube Reinforced Artificial Bone Tissue**  
K. PourAkbar Saffar\*, G. Rouhi, A. Raeisi Najafi, A.R. Arshi, L. Sudak, N. JamilPour  
*Amirkabir University of Technology, Tehran, Iran*
- 11:30 T04.011 **Mode of Failure of a Biomaterial Composite Scaffold for Bone Tissue Engineering using Synchrotron Micro-tomography and Finite Element Analysis**  
D. Lacroix\*, J.L. Milan, C. Sandino, S. Midderhoff, L. Marquez, J.A. Planell  
*Institute For Bioengineering Of Catalonia, Technical University of Catalonia, Barcelona, Spain*
- 11:50 T04.013 **Structural Characterization of Chitosan-Grafted Polyurethanes**  
M.C. Tanzi\*, Paola Petrini, G. Bianchi, C. Perrino, S. Bozzini  
*Politecnico Di Milano, Milano, Italy*

**T04-S2****Monday July 13, 15:30 – 16:50**

Conference Centre - Rideau Room

Chair: M.C. Tanzi, *Politecnico Di Milano, Milano, Italy*

- 15:30 T04.003 **Electrochemical Deposition of Calcium Phosphate for Implant Osseointegration and Drug Release**  
R. Chiesa\*, L. De Nardo, D. Pedretti, A. Cigada  
*Politecnico Di Milano, Milano, Italy*
- 15:50 T04.006 **Characterization of Explanted Bileaflet Mechanical Heart Valves and Correlation with Patients' Clinical Data**  
S. Farè\*, M.F. Brunella, G. Bruschi  
*Politecnico di Milano, Milan, Italy*
- 16:10 T04.007 **Electromagnetically Stimulated SAOS-2 Osteoblasts inside a Porous Hydroxyapatite Scaffold in Vitro**  
L. Fassina\*, L. Visai, E. Saino, M.S. Sbarra, G. Magenes  
*University of Pavia, Italy*
- 16:30 T04.008 **Electrochemical Characterization of Passivity Breakdown and Repassivation on Ti, Ni-Ti and Ti Based Alloys in Simulated Body Fluid Under Rapid Mechanical Deformation**  
S. Fujimoto\*, H. Yamamoto  
*Osaka University, Suita, Japan*

**T04- S3****Tuesday July 14, 10:30 – 12:10**

Conference Centre - Rideau Room

Chair: E.K. Oneida, *Cornell University, USA*

- 10:30 T04.017 **Notch-Tip Strain Fields in an Aluminum Sheet with Serrated Plasticity**  
W. Tong\*, Y. Xuan  
*Southern Methodist University, Dallas, USA*
- 10:50 T04.005 **Yield Surface of a Fiber Network: A First Way to Explore the Process of Rupture of Biological Tissues**  
M. Coret\*, T. Chaise  
*INSA-Lyon/LaMCoS, CNRS UMR5259, Villeurbanne, France*
- 11:10 T04.001 **Micromechanics of Fracture in Nacre from Mollusk Shells**  
F. Barthelat\*, R. Rabiei  
*McGill University, Montréal, Canada*
- 11:30 T04.016 **Breast Implants Failure: Correlation of Explanted Implants Properties and Patient's Clinical Data**  
S. Bertoldi\*, M.C. Tanzi, A. Menozzi, A. Spano, M. Nava, S. Farè  
*Politecnico di Milano, Milan, Italy*
- 11:50 T14.011 **On the Study of Wire Cutting of Starch Gels**  
J.G. Williams\*, C. Gamonpilas, M. Charalambides, P.J. Dooling, S.R. Gibbon  
*Imperial College London, UK*

**T05-S1****Wednesday July 15, 15:30 -17:10**

Conference Centre - Colonel By Room

Chair: M. Hoffman, *University Of New South Wales, Australia*

- 15:30 T05.002 **Keynote Presentation**  
**Strength Evaluation of Borosilicate Glass Coated with Thin Ceramic Films by Radio-Frequency Sputtering**  
T. Hoshide\*, M. Hirano  
*Kyoto University, Kyoto, Japan*
- 16:10 T05.003 **Notch Sensitivity and Fracture Resistance of Non-Woven Felts**  
A. Ridruejo\*, C. González, J. Llorca  
*Universidad Politécnica De Madrid, Spain*
- 16:30 T05.004 **Numerical Estimation of Crack Behaviour and Apparent Fracture Toughness of Layered Composites with Strong Interfaces**  
L. Náhlík\*, L. Sestakova, P. Hutar  
*Institute of Physics of Materials, Academy Of Sciences Of The Czech Republic, Brno, Czech Republic*
- 16:50 T05.005 **Analysis of Crack-Tip Process Zones in Cyclic and Monotonic Loading in Piezoelectric Ceramics Using High-Energy X-Rays**  
M. Hoffman\*, S. Imlao, J. Russell, J. Jones, J. Daniels  
*University Of New South Wales, Sydney, Australia*

**T06-S1****Monday July 13, 10:30 – 12:10**

Conference Centre - Main Hall

Chair: A.R. Ingraffea, *Cornell University, USA*

- 10:30 T06.051 **Keynote Presentation**  
**Crack Analysis in 3-D Axisymmetric Piezoelectric Solids**  
 J. Sladek\*, V. Sladek, P. Solec  
*Slovak Academy Of Sciences, Bratislava, Slovakia*
- 11:10 T06.048 **Fracture Toughness of 2D Low Density Periodic Material**  
 M. Ryvkin\*, F. Lipperman, M.B. Fuchs  
*Tel Aviv University, Tel Aviv, Israel*
- 11:30 T06.049 **Evaluation of the Hypersingular Kernel for a Three-Dimensional Exponentially Graded Material**  
 L.J. Gray\*, O. Sallah, S.N. Fata  
*Oak Ridge National Laboratory, Oak Ridge, USA*
- 11:50 T06.050 **A Numerical Scheme for Three-Dimensional Curved Crack Propagation Based on Maximum Dissipation and Configurational Forces**  
 H. Schuette\*  
*Institute of Mechanics, Ruhr-University of Bochum, Germany*

**T06-S2****Monday July 13, 15:30 – 17:10**

Conference Centre - Main Hall

Chair: L. Banks-Sills, *Tel Aviv University, Israel*

- 15:30 T06.006 **Modelling of Mechanical Behaviour of Polymer/Clay Nanocomposites**  
 T. Boukharouba\*, A. Mesbah, S. Boutaleb, F. Zairi, J.M. Gloaguen, M. Nait Abdelaziz,  
 J.M. Lefebvre, K. Azouaoui  
*(UMR CNRS 8107), USTL, Polytech'Lille, France,*
- 15:50 T06.007 **Stress Concentration around a Strongly Oblate Spheroidal Cavity in a Cubic Crystal and its Associated Penny-Shaped Crack Problems**  
 C.-R. Chiang\*  
*National Tsing Hua University, Hsin Chu, Taiwan*
- 16:10 T06.008 **Size-Scale Effects on the Ductility of Reinforced Concrete Structural Elements**  
 M. Corrado\*, A. Carpinteri, M. Paggi  
*Politecnico di Torino, Torino, Italy*
- 16:30 T06.009 **Shear Retention and Mesh Alignment during Fracture Using Sequentially Linear Analysis**  
 M.J. DeJong\*, M.A.N. Hendriks, J.G. Rots  
*Massachusetts Institute of Technology, Cambridge, USA*
- 16:50 T06.052 **Integral Representation of the Singular Fields Intensity Factors**  
 V. Sladek\*, J. Sladek, Ch. Zhang  
*Slovak Academy Of Sciences, Bratislava, Slovakia*

**T06-S3****Tuesday July 14, 10:30 – 12:10**

Conference Centre - Main Hall

Chair: V. Sladek, *Slovak Academy Of Sciences, Slovakia*

- 10:30 T06.031 **Keynote Presentation**  
**Computational Model of the Transition of Crack across the Sharp Material Interface**  
M. Kotoul\*, T. Profant, O. Sevecek, J. Klusak  
*Brno University Of Technology, Brno, Czech Republic*
- 11:10 T06.056 **An Integration Method for a Unified Constitutive Model**  
S. Xu\*, G. Quan, C. Sloss  
*Wescast Industries Inc., Brantford, Canada*
- 11:30 T06.057 **Analysis of Mixed-Mode Fatigue Crack Growth using Cyclic Cohesive Models and XFEM**  
H. Yuan\*, Y. Xu  
*University Of Wuppertal, Wuppertal, Germany*
- 11:50 T06.034 **Interaction of Double Circular Holes and a Linear Crack**  
H-L. Li\*, H. Li, C. Zhang  
*Harbin Engineering University, Harbin, China*

**T06-S4****Tuesday July 14, 15:30 – 16:50**

Conference Centre - Main Hall

Chair: J. Sladek, *Slovak Academy Of Sciences, Slovakia*

- 15:30 T06.019 **SIF and T Stress Computation via Boundary Integral Equations**  
L.J. Gray\*, A. Salvadori, A.-V. Phan  
*Oak Ridge National Laboratory, Oak Ridge, USA*
- 15:50 T06.015 **A Crack Tip Condensed Plasticity Model Coupled with Acceleration Techniques Based on Reduced Order Model Approach for 3D Crack Growth**  
F. Galland\*, A. Gravouil, M. Rochette, S. Perrin  
*INSA de Lyon, Villeurbanne, France*
- 16:10 T06.022 **Extension of the Hybridization Weight Function Approach to Corner Cracks**  
M. Haboussi\*, B.K. Hachi, S. Rechak, A. Nour, G. Maurice  
*Djelfa University, Djelfa, Algeria*
- 16:30 T06.024 **Crack Propagation Simulations in Piezoelectric Structures with an Efficient Adaptive Finite Element Tool**  
L. Janski\*, M. Kuna  
*Technische Universitat Bergakademie Freiberg, Germany*

**T06-S5****Wednesday July 15, 10:30 – 12:10**

Conference Centre - Main Hall

Chair: H.A. Mang, *Vienna University of Technology, Austria*

- 10:30 T06.025 **Effect of Crack Orientation on the Natural Frequencies and Amplitudes of a Cracked Rectangular Plate**  
P.V. Joshi\*, S.K. Dhagat  
*SSCET Junwani, Bhilai, Chhattisgarh, India*
- 10:50 T06.026 **Modelization of Prestressed or Reinforced Concrete Beams until Fracture in Non Linear Elasticity**  
M.S. Kachi\*, Y.F. Bouafia, P. Muller  
*Université de Tizi ousou, Tizi Ouzou, Algérie*
- 11:10 T06.016 **Analysis of Bending of Anisotropic Plates Using the Hypersingular Formulation of BEM**  
F. García-Sánchez\*, M. Wünsche, A. Sáez  
*Universidad de Sevilla, Sevilla, Spain*
- 11:30 T06.028 **Asymptotic Fields Ahead of Cohesive Cracks**  
B.L. Karihaloo\*, Q.Z. Xiao  
*Cardiff University, Cardiff, UK*
- 11:50 T06.002 **The Effect of Out-of-Plane Deformation on Interface Fracture**  
L. Banks-Sills\*, N. Konovalov, A. Fliesher  
*Tel Aviv University, Ramat Aviv, Israel*

**T06-S6****Wednesday July 15, 13:30 – 14:50**

Conference Centre - Main Hall

Chair: P.O. Bouchard, *CEMEF - Mines ParisTech, France*

- 13:30 T06.042 **Quasi-static Failure Modes of Silicon Dies**  
H. Quade\*, K. Weinberg, A. Pandolfi  
*Politecnico di Milano, Milano, Italy*
- 13:50 T06.033 **Size Effect on Strength of Bimaterial Joints: Computational Approach versus Analysis and Experiment**  
J.-L. Le\*, F.C. Caner, Q. Yu, Z.P. Bazant  
*Northwestern University, Evanston, USA*
- 14:10 T06.001 **Crack Growth Modelling in Single Crystals based on Microdamage Continuum**  
O. Aslan\*, S. Forest, S. Quilici  
*Centre des Matériaux, Mines, ParisTech, UMR CNRS 7633, France*
- 14:30 T06.036 **Fracture Analysis with Adaptive Nearest-Nodes Finite Element Method**  
Y. Luo\*  
*University of Manitoba, Winnipeg, Canada*



**T06-S7****Wednesday July 15, 15:30 – 16:50**

Conference Centre - Main Hall

Chair: M. Kotoul, *Brno University Of Technology, Czech Republic*

- 15:30 T06.037 **DEM Simulations of the Progressive Collapse of Framed Structures**  
B.M. Chiaia\*, E. Masoero, F.K. Wittel, H.J. Herrmann  
*Politecnico Di Torino, Italy*
- 15:50 T06.038 **A New Computational Framework for Fatigue Crack Growth Analysis of Components**  
R.C. McClung\*, Y.-D. Lee, M.P. Enright, S.H.K. Fitch  
*Southwest Research Institute, San Antonio, USA*
- 16:10 T06.039 **Behaviour of a T-Joint Connection of Thin-Walled Tubes under a Multi-Axial State of Stress**  
R. Moazed\*, R. Fotouhi, J. Henry  
*University Of Saskatchewan, Saskatoon, Canada*
- 16:30 T06.040 **Improved Extended Finite Element Method to Handle Topological Changes in Crack Growth**  
N. Moës\*, C. Stolz, N. Chevaugeon  
*École Centrale De Nantes, France*

**T06-S8****Session in honor of the retirement of Dietmar Gross, Tu Darmstadt, Germany****Monday July 13, 10:30 – 12:10**

Conference Centre – Centennial Room

Chair: Ch. Zhang, *University of Siegen, Germany*

- 10:30 T06.020 **Keynote Presentation**  
**Numerical Simulation of Size Effects and Damage in Thin Metallic Films during Nano-Indentation**  
D. Gross\*, A. Trondl  
*TU Darmstadt, Darmstadt, Germany*
- 11:10 T06.032 **Constitutive Description of the Damage Process in Lead Free Solder Alloys**  
M. Kuna\*, S. Wippler  
*TU Bergakademie Freiberg, Freiberg, Germany*
- 11:30 T06.003 **Numerical Analysis of Brittle Failure in Notched Structures by Means of a Finite Fracture Mechanics Model**  
W. Becker\*, J. Hebel, R. Dieringer  
*Technische Universität Darmstadt, Germany*
- 11:50 T06.044 **Analytical Solution for Dislocations in an Elastic Solid with Surface Stress**  
R.K.N.D. Rajapakse\*, P. Intarit, T. Senjuntichai  
*University Of British Columbia, Vancouver, Canada*

## T06-S9

Session in honor of the retirement of Dietmar Gross, Tu Darmstadt, Germany

Monday July 13, 15:30 – 17:10

Conference Centre – Centennial Room

Chair: R. Müller, TU Darmstadt, Germany

- 15:30 T06.027 **Keynote Presentation**  
**Discrete Crack Path Prediction with an Adaptive Cohesive Crack Model**  
M. Kaliske\*, G. Geißler, Ch. Morgner  
*Institute For Structural Analysis, Technische Universität Dresden, Germany*
- 16:10 T06.014 **Dislocation-Based Finite Element Method for Calculating Stress Intensity Factors of Cracks**  
X.-Q. Feng\*, X.-Y. Wang, Y.-F. Shi, S.-W. Yu  
*Tsinghua University, Beijing, China*
- 16:30 T06.011 **A General Mass Lumping Technique for X-FEM Explicit Dynamics Simulations. Application to 2D and 3D Dynamic Crack Growth**  
T. Elguedj\*, A. Gravouil, H. Maigre  
*Lamcos - INSA de Lyon, Lyon, France*
- 16:50 T06.054 **Three Dimensional Finite Element Modeling of Nonlinear Fracture of Ferroelectric Materials**  
J. Wang\*, M. Kamlah  
*Forschungszentrum Karlsruhe, Institute of Material Research II, Karlsruhe, Germany*
- 17:10 T36.017 **FE-Modeling of Damage Propagation in Axially Compressed Composite Airframe Panels**  
W. Wagner\*, C. Balzani  
*University Of Karlsruhe (TH), Germany*

## T06-S10

Session in honor of the retirement of Dietmar Gross, Tu Darmstadt, Germany

Tuesday July 14, 10:30 – 12:10

Conference Centre – Centennial Room

Chair: R. Kienzler, University of Bremen, Germany

- 10:30 T06.017 **Keynote Presentation**  
**Crack Detection by Wave Propagation in Overhead Transmission Lines**  
L. Gaul\*, T. Haag, H. Sprenger  
*University of Stuttgart, Institute of Applied and Experimental Mechanics, Stuttgart, Germany*
- 11:10 T06.058 **Interface Cracks in Anisotropic Elastic Solids under Impact Loading**  
Ch. Zhang\*, M. Wuensche  
*University of Siegen, Germany*
- 11:30 T06.041 **A Continuum Phase Field Model for Fracture**  
R. Müller\*, Ch. Kuhn  
*TU Darmstadt, Germany*
- 11:50 T06.023 **An Enhanced Model for Probabilistic Cleavage Fracture Assessment Considering Local Constraint Effects**  
J. Hohe\*, V. Hardenacke, S. Luckow, D. Siegele  
*Fraunhofer Institut für Werkstoffmechanik, Freiburg, Germany*

## T06-S11

Session in honor of the retirement of Dietmar Gross, Tu Darmstadt, Germany

Tuesday July 14, 15:30 – 16:50

Conference Centre - Centennial Hall

Chair: W. Becker, *Technische Universität Darmstadt, Germany*

- 15:30 T06.030 **The Configurational Forces Concept - A New Tool for the Design of Damage Resistant Materials**  
R. Schöngrundner\*, F.D. Fischer, J. Predan, O. Kolednik  
*Erich Schmid Institute Of Materials Science, Austrian Academy Of Sciences, Leoben, Austria*
- 15:50 T06.045 **Dynamic Analysis of Cracked Plates by The Extended Finite Element Method (X-FEM)**  
S. Rechak\*, M. Bachene, R. Tiberkak, B.K. Hachi  
*National Polytechnic School of Algiers, University of Boumerdes, Algeria*
- 16:10 T06.046 **Dynamic Crack Propagation from the Macro to the Micro-Scale in a Partition of Unity Context**  
J. Réthoré\*, P. Aubertin, R. de Borst  
*LaMCoS INSA Lyon / CNRS, Villeurbanne, France*
- 16:30 T06.029 **Treating Mixed-Mode Problems with Path-Independent Integrals**  
R.Kienzler\*, L. Rohde, R. Schröder, K. Kutz  
*University of Bremen, Bremen, Germany*

## T06-S12

Wednesday July 15, 15:30 – 17:10

Conference Centre – Centennial Room

Chair: T. Elguedj, *Lamcos - INSA de Lyon, France*

- 15:30 T06.053 **A Geometric Approach to Stochastically Modeling Fatigue Crack Propagation at the Microstructural Length Scale**  
M.G. Veilleux\*, J.D. Hochhalter, J.E. Bozek, P.A. Wawrzynek, A.R. Ingraffea  
*Cornell University, Ithaca, USA*
- 15:50 T06.047 **Determination of Strength of Singularity Induced by Discontinuity in a Three-dimensional, Linear, Finite Domain**  
J. Rungamornrat\*  
*Chulalongkorn University, Bangkok, Thailand*
- 16:10 T06.059 **Development X-FEM to Investigate Crack Propagation in Inhomogeneous Materials**  
Z. Zhuang\*, B.B. Cheng  
*School of Aerospace, Tsinghua University, Beijing, China*
- 16:30 T06.035 **Three-Dimensional Fracture Mechanics Development for Life Assessment of Components**  
A. Loghin\*, A.C. Kaya, Y. Potdar, J. LeMonds, U. Ozkan, G. Khan, R. McClain, J. Laflen  
*General Electric Global Research Center, Niskayuna, USA*
- 16:50 T06.005 **A Multiscale Analysis of Ductile Steel Grades Damage and Fracture Mechanisms**  
P.O. Bouchard\*, L. Bourgeon, R.E. Loge, E. Maire, C. Verdu  
*CEMEF - Mines ParisTech, Sophia-antipolis, France*

**T07-S1****Monday July 13, 10:30 – 12:10**

Conference Centre - Gatineau Room

Chair: E. Schlangen, *Delft University of Technology, The Netherlands*

- 10:30 T07.001 **An Experimental Test for Cracking Concrete under Controlled Conditions**  
C. Boulay\*, S. Dal Pont, A. Delaplace, J.L. Tailhan, H. Delahousse  
*French Public Works Research Laboratory, BCC-LCPC, Paris, France*
- 10:50 T07.002 **Micro-Macro Modeling of Concrete**  
S. Dal Pont\*, J-L. Tailhan, P. Rossi  
*French Public Works Research Laboratory, BCC-LCPC Paris, France*
- 11:10 T07.003 **A Coupled Finite Element - Discrete Element Approach for a Fine Estimation of the Crack Pattern in Concrete Subjected to THM Loading**  
A. Delaplace\*, B. Bary, G. Kwimang  
*LMT, ENS Cachan/CNRS/UPMC/PRES UniverSud Paris, Cachan, France*
- 11:30 T07.004 **Influence of Aggregate Size on Shrinkage Induced Micro-Cracking of Mortar and Concrete**  
P. Grassl\*, H.S. Wong, N.R. Buenfeld  
*University Of Glasgow, Glasgow, UK*
- 11:50 T07.006 **Modelization and Influence of Shear Retention Parameter on the Response of Reinforced Concrete Structural Elements**  
R. Mehaddene\*, L. Dahmani, S. Drizi  
*Université Mouloud Mammeri, Tizi-Ouzou, Algérie*

**T07-S2****Monday July 13, 15:30 – 17:30**

Conference Centre - Gatineau Room

Chair: R.B. Tait, *University of Cape Town, South Africa*

- 15:30 T07.008 **Effect of the Loading Rate on the Fracture Behavior of High-Strength Concrete**  
G. Ruiz\*, J.R. del Viso, X.X. Zhang, R.C. Yu, R. Porras, E. Poveda  
*Universidad de Castilla-La Mancha, Ciudad Real, Spain*
- 15:50 T07.009 **Discussion on Relationship between Fracture Energy and Fractured Area of Concrete-to-Concrete Surfaces**  
A. Satoh\*, K. Yamada, S. Ishiyama  
*Akita Prefecture University, Yurihonjo, Japan*
- 16:10 T07.010 **Simulation of Fracture in Fibre Cement Based Materials with a Micro-Mechanical Lattice Model**  
E. Schlangen\*, Z. Qian, M.G. Sierra-Beltran, J. Zhou  
*Delft University of Technology, CEG, Microlab, Delft, The Netherlands*
- 16:30 T07.007 **Tensile Behavior Prediction of Cement Paste Using 3D Lattice Model**  
Z. Qian\*, G. Ye, E. Schlangen, K. van Breugel  
*Delft University of Technology, Delft, The Netherlands*
- 16:50 T07.012 **Methodology of Damage Assessment in Concrete Scope and Restrictions**  
P. Stroeven\*  
*Delft University of Technology, Delft, The Netherlands*
- 17:10 T07.011 **Fatigue and Fracture Parameters of Various Glass Fiber Cement Based Composites**  
S. Seitl\*, Z. Kersner, V. Bilek, Z. Knesl  
*Institute of Physics of Materials, Academy of Sciences of The Czech Republic, Brno, Czech Republic*

**T07-S3**

Tuesday July 14, 10:30 – 12:30

Conference Centre - Gatineau Room

Chair: P. Grassl, *University Of Glasgow, UK*

- 10:30 T07.013 **Damage Quantification of Concrete Surface Layers by Semi-Variogram Analysis**  
T. Suzuki\*, M. Aoki, M. Ohtsu  
*Nihon University, Fujisawa, Kanagawa, Japan*
- 10:50 T07.015 **A Loading-rate Dependent Cohesive Model To Simulate Concrete Fracture**  
R.C. Yu\*, A.L. Rosa, G. Ruiz, J.L.A.O. Souza  
*Universidad de Castilla-La Mancha, Ciudad Real, Spain*
- 11:10 T07.016 **Modeling the Bond and Failure Behavior of Continuous Yarn Reinforced Cement Composites**  
X.B. Zhang\*, B. Fiorio, H. Aljewifi, R. Cabrillac, J. Li  
*Université Blaise Pascal - Clermont II, LaMI, Montluçon, France*
- 11:30 T07.005 **A Coupled Two-Scale Computational Approach for Masonry Out-of-Plane Failure**  
T.J. Massart\*, B.C.N. Mercatoris  
*Université Libre De Bruxelles (U.L.B.), Brussels, Belgium*
- 11:50 T07.014 **Fracture and Slow Crack Characteristics of Nuclear Grade Graphite using the Double Torsion Beam Technique**  
R.B. Tait\*, T.H. Becker  
*University of Cape Town, Cape Town, South Africa*
- 12:10 T07.017 **New Self-Compacting Concrete Containing Carbon Nanotubes**  
G. Ferro\*, S. Musso, A. Tagliaferro, J.-M. Tulliani  
*Politecnico di Torino, Turin, Italy*

**T08-S1****Tuesday July 14, 10:30 – 12:10**

Conference Centre - Colonel By Room

Chair: Y.J. Chao, *University of South Carolina, USA*

- 10:30 T08.007 **Keynote Presentation**  
**Three-Dimensional Constraint Theory: Bridge the Gap from Laboratory Material Tests to Fatigue Fracture of Engineering Structures**  
W.L. Guo\*, P.S. Yu, Z.B. Yu  
*Nanjing University Of Aeronautics And Astronautics, Nanjing, China*
- 11:10 T08.004 **Constraint Effect in Fracture - What is it ?**  
Y.J. Chao\*, P.-S. Lam  
*University of South Carolina, Columbia, USA*
- 11:30 T08.006 **On the T-Stress and its Influence on the Constraint Due to Specimen Thickness and Crack Length under Mode-I Loading**  
A. Fernández-Canteli\*, J. Fernández Sáez, D. Fernández Zúñiga  
*EPSIG, University of Oviedo, Oviedo, Spain*
- 11:50 T08.018 **The Effect of T-stress on Crack Tip Plastic Zones under Mixed Mode Loading Conditions**  
X. Wang\*, R. Bell, Q. Nazarali  
*Carleton University, Ottawa, Canada*

**T08-S2****Tuesday July 14, 15:30 – 17:10**

Conference Centre - Colonel By Room

Chair: X. Wang, *Carleton University, Canada*

- 15:30 T08.002 **Fracture Behaviour of 2024 Aluminium Alloy with Discreet 1D Residual Stress Fields**  
D.T. Asquith\*, Y.H. Tai, J.R. Yates  
*University Of Sheffield, UK*
- 15:50 T08.003 **Effect of Specimen Crack Depth and Thickness on Initiation Fracture Behaviour of Highly Ductile Low Carbon Steels**  
S. Bansal\*, S.K. Nath, P.K. Ghosh, S. Ray  
*Indian Institute Of Technology Roorkee, Roorkee, India*
- 16:10 T08.017 **Effect of Residual Stress on Fracture Behavior by Cohesive Zone Modeling**  
X.B. Ren\*, Z.L. Zhang, B. Nyhus  
*Norwegian University of Science and Technology, Trondheim, Norway*
- 16:30 T08.016 **In and Out-of-Plane Constraint Measures. Uniform Description**  
A. Neimitz\*, M. Graba  
*Kielce University of Technology, Kielce, Poland*
- 16:50 T08.015 **Effect of Constraint on Stretch Zone Width and Fracture Toughness of Structural Steels**  
N. Narasaiah\*, M. Tarafder, S. Sivaprasad, S. Tarafder  
*National Metallurgical Laboratory, CSIR, Jamshedpur, India*

**T08-S3****Wednesday July 15, 10:30 – 11:50**

Conference Centre - Colonel By Room

Chair: A. Fernández-Canteli, *EPSIG, University of Oviedo, Spain*

- 10:30 T08.009 **Strain Constraint of Circumferentially Notched Tensile Specimens for the Alternative Fracture Toughness Evaluation**  
K. Kasaba\*, A. Nishimura, N. Kazamaki  
*Iwate University, Ueda, Morioka, Japan*
- 10:50 T08.019 **R-Curve Testing and Modelling with Constraint Effect**  
S.D. Smith\*, W.G. Xu, D.W. Zhou  
*Structural Integrity Technology Group, TWI Ltd, Cambridge, UK*
- 11:10 T08.011 **Effective Experimental Measurement and Constraint Quantification of J-R Curves for X80 Pipeline Steel**  
X.K. Zhu\*, B.N. Leis, G. Shen, W.R. Tyson  
*Battelle Memorial Institute, Columbus, USA*
- 11:30 T08.013 **Estimation of Constraint under Cyclic Loading on Cracked Components**  
M. Madia\*, S. Beretta  
*Politecnico Di Milano, Milan, Italy*

**T08-S4****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Colonel By Room

Chair: B.N. Leis, *Battelle Memorial Institute, USA*

- 13:30 T08.014 **The Effect of Out-of-Plane Loading on the Fracture of Aluminium 2024**  
M. Mostafavi\*, D.J. Smith, M.J. Pavier  
*University of Bristol, Bristol, UK*
- 13:50 T08.012 **The Effects of Loading History and Crack Geometry on Time-Dependent Fatigue Crack Growth at Elevated to High Temperatures**  
F. Ma\*, D. Lehmann, T. Morrison  
*Pratt and Whitney, East Hartford, USA*
- 14:10 T08.008 **Effect of Specimen Geometry on Fatigue Crack Propagation in Threshold Region**  
P. Hutar\*, S. Seitzl, T. Kruml  
*Institute Of Physics Of Materials, Academy Of Sciences Of The Czech Republic, Brno, Czech Republic*
- 14:30 T08.001 **A Modified Weibull Stress Model for Cleavage Fracture that Incorporates Threshold Toughness**  
T.L. Anderson\*, B.D. Rose  
*Quest Reliability, Boulder, USA*
- 14:50 T08.005 **Account of Mismatching Effect Based on Constraint in Welded Joints and Fracture Toughness Predication**  
Z.-A. Chen\*, G.-Z. Li, Y.J. Chao, J. Zeng  
*Jiangsu University, Zhenjiang, China*

**T09-S1****Monday July 13, 10:30 – 12:10**

Westin Hotel - Governor General III Room

Chair: W. Dietzel, *GKSS-Forschungszentrum Geesthacht, Germany*

- 10:30 T09.023 **Keynote Presentation**  
**Stress Corrosion Cracking of Oil and Gas Pipelines: New Insights on Crack Growth Behaviour Gained from Full-Scale and Small Scale Tests**  
W. Zheng\*, D. Bibby, J. Li, G. Williams, W. Revie, B. Tyson  
*Natural Resources Canada - CANMET, Ottawa, Canada*
- 11:10 T09.001 **Grain Boundary Engineering to Control the Intergranular Stress Corrosion Cracking of Pipeline Steel**  
M.A. Arafin\*, J.A. Szpunar  
*McGill University, Montréal, Canada*
- 11:30 T09.002 **Study of Liquid Metal Embrittlement of Steels by EBSD**  
T. Auger\*, L. Medina-Almazana, C. Rey, P. Bompard, D. Gorse  
*MSSMAT-ECP, UMR CNRS 8579, Chatenay-Malabry, France*
- 11:50 T09.003 **Stress Corrosion Crack Growth beneath a Stiff Coating - Influence of Chemical Potential and Interface Toughness**  
C. Bjerkén\*, M. Ortiz, J. Rimoli  
*Malmö University, Malmö, Sweden*

**T09-S2****Monday July 13, 15:30 – 16:50**

Westin Hotel - Governor General III Room

Chair: J.A. Duff, *University Of Manchester, UK*

- 15:30 T09.006 **Quantum Chemical Molecular Dynamics Study of Strain Effect on the Oxygen Diffusion in fcc Fe (111) and Fe-Cr (111) Surfaces at 288 oC**  
N.K. Das\*, K. Suzuki, Y. Takeda, T. Shoji  
*Fracture and Reliability Research Institute, Tohoku University, Sendai, Japan*
- 15:50 T09.007 **Transition from Pits to Cracks in Pipeline Steel in Near-Neutral pH Solution**  
R.L. Eadie\*, B. Fang, M. Elboujdaini, W. Chen  
*University of Alberta, Edmonton, Canada*
- 16:10 T09.008 **Physical-Chemistry Aspects of Water in Steam Turbines Blades Associated with Material Stress and Electrochemical Assessment of the AISI 403 to Simulate Real Conditions**  
C.V. Franco\*, D.S. Pacheco, J.F. Godinho, W.A. Frech, G.G. Sonai, L.A.M. Torres, A.R.F. Ellwanger  
*Universidade Federal De Santa Catarina, Florianópolis, Brazil*
- 16:30 T09.024 **Susceptibility of Steels containing Cr, Ni, and Mo in H<sub>2</sub>S Environments**  
M Elboujdaini\*  
*Natural Resources Canada - CANMET, Ottawa, Canada*



**T09-S3**

Tuesday July 14, 10:30 – 11:50

Westin Hotel - Governor General III Room

Chair: R.L. Eadie, *University of Alberta, Canada*

- 10:30 T09.013 **Environmentally Assisted Cracking and Corrosion Fatigue Crack Growth of Zr-Based Bulk Metallic Glass**  
Y. Nakai\*, Y. Yoshioka  
*Kobe University, Kobe, Japan*
- 10:50 T09.014 **A Novel Fracture Mechanics Approach to Determine the Threshold Stress Intensity Factor in Corrosive Environment**  
S. Pal\*, R.K. Singh Raman, R.N. Ibrahim  
*Monash University, Melbourne, Australia*
- 11:10 T09.016 **Cohesive Zone Model for Intergranular Environmental and Stress Assisted Failure and Analysis of Slow Crack Growth in Ceramic Polycrystals**  
M. Romero de la Osa\*, R. Estevez, C. Olagnon, J. Chevalier, C. Tallaron  
*Université de Lyon, INSA Lyon, MATEIS CNRS 5510, Villeurbanne, France*
- 11:30 T09.018 **Durability Investigation of Patch-Repaired Reinforced Concrete**  
H. Saricimen\*, M. Shameem, M. Maslehuddin, M. Ibrahim, M.S. Barry  
*King Fahd University Of Petroleum And Minerals, Dhahran, Saudi Arabia*

**T09-S4**

Tuesday July 14, 15:30 – 17:10

Westin Hotel - Governor General III Room

Chair: W. Zheng, *Natural Resources Canada - CANMET, Canada*

- 15:30 T09.019 **Creep Fracture and Grain Structure of Pure ECAP Aluminum and Copper**  
I. Saxl\*, V. Sklenièka, L. Ilucová, M. Svoboda, P. Král, J. Dvořák  
*Mathematical Institute, Academy of Sciences of the Czech Republic, Praha, Czech Republic*
- 15:50 T09.020 **Structural Disintegration of Al-2024 Rolled Plates in a Marine Environment - Effect of Morphological Parameters of the Microstructure**  
J. Stolarz\*, G. Blanc  
*École Nationale Supérieure Des Mines, Saint-Etienne, France*
- 16:10 T09.021 **Monte Carlo Simulation of Stress Corrosion Cracking in an Austenitic Stainless Steel Type 304**  
H. Suzuki\*, K. Tohgo, Y. Shimamura, G. Nakayama, Y. Sakakibara  
*Shizuoka University, Hamamatsu, Japan*
- 16:30 T09.022 **Imaging Autoclave Development for In-Situ Optical Measurement of High Temperature Aqueous Corrosion Processes**  
J.A. Duff\*, P. Wood, T.J. Marrow  
*University Of Manchester, UK*
- 16:50 T19.013 **Transient Hydrogen Diffusion Analyses of a Surface Crack in a Three-Dimensional Body**  
N. Miyazaki\*, H. Kotake, R. Matsumoto, S. Taketomi  
*Kyoto University, Kyoto, Japan*

**T09-S5**

**Wednesday July 15, 10:30 – 11:30**

Westin Hotel - Governor General III Room

Chair: C.V. Franco, *Universidade Federal De Santa Catarina, Brazil*

- 10:30 T09.017 **Metallic Corrosion in Industry (Case Studies)**  
F.M. Saeed\*, A.A. Odeh  
*Royal Scientific Society, Amman, Jordan*
- 10:50 T09.004 **Microscopic Visualization and Quantification of the Synergism of Stress and Hydrogen at Crack-Tip during Pipeline SCC**  
Y.F. Cheng\*, X. Tang  
*University of Calgary, Calgary, Canada*
- 11:10 T09.011 **Effect of Surface Condition on the Chloride-Induced Depassivation of Rebar in Concrete**  
P. Ghods\*, O.B. Isgor, G. McRae, G.P. Gu, J. Li  
*Carleton University, Ottawa, Canada*

**T10-S1****Monday July 13, 10:30 – 12:10**

Conference Centre - Sussex Room

Chair: K. Saanouni, *ICD-Lasmis University Of Technology Of Troyes, France*

- 10:30 T10.001 **3D vs Plane Stress Formulations of Anisotropic Non Normal Plastic and Damaged Model for Sheet Metal Forming**  
H. Badreddine\*, K. Saanouni  
*ICD-Lasmis University Of Technology Of Troyes, France*
- 10:50 T10.002 **Analysis of Damage in Metallic Materials by X-ray Tomography**  
A. Bareggi\*, E. Maire, M. Giton, O. Bouaziz, M. Dimichiel  
*INSA de Lyon, Villeurbanne (Lyon), France*
- 11:10 T10.003 **Finite-Element Analyses of Combined Void Shape and Plastic Anisotropy Effects in Ductile Fracture**  
A.A. Benzerga\*, S.M. Keralavarma  
*Texas A & M University, College Station, USA*
- 11:30 T10.004 **Experimental and Numerical Investigation of the Effect of Off-Fault Damage on Dynamic Earthquake Rupture Propagation**  
H.S. Bhat\*, R.L. Biegel, A.J. Rosakis, C.G. Sammis  
*University Of Southern California, Los Angeles, USA*
- 11:50 T10.005 **Dwell-Fatigue in Near Alpha Titanium Alloys: A Multiscale, Interdisciplinary Challenge**  
P. Bocher\*, F. Bridier, L. Toubal, N. Boutana, E. Uta, N. Gey, M. Humbert  
*École de Technologie Supérieure, Montréal, Canada*

**T10-S2****Monday July 13, 15:30 – 17:10**

Conference Centre - Sussex Room

Chair: D.S. Wilkinson, *McMaster University, Canada*

- 15:30 T10.006 **A Cohesive-Frictional Interface Model with Frictional Properties Degradation**  
G. Borino\*, B. Failla, F. Parrinello  
*University of Palermo, Palermo, Italy*
- 15:50 T10.007 **Stochastic Framework for Predicting Microstructurally Small Fatigue Life of AA 7075-T651**  
J.E. Bozek\*, M.G. Veilleux, J.D. Hochhalter, P.A. Wawrzynek, A.R. Ingraffea  
*Cornell Fracture Group, Cornell University, Ithaca, USA*
- 16:10 T10.008 **A Stress-Triaxiality-Dependent Damage Model and Fracture Criterion for Aluminum Alloys**  
M. Bruenig\*, S. Gerke, D. Albrecht  
*Dortmund University of Technology, Dortmund, Germany*
- 16:30 T10.009 **Damage Percolation Modeling of Void Nucleation in Aluminum Alloy Sheet**  
C.J. Butcher\*, Z.T. Chen  
*University Of New Brunswick, Fredericton, Canada*
- 16:50 T10.010 **Effect of Crack-Crazing Patterns Interactions on Energy Release Rates**  
M. Chabaat\*, H. Seddiki  
*University Of Sciences And Technology Houari Boumediene, Algiers, Algeria*

**T10-S3**

Tuesday July 14, 10:30 – 12:10

Conference Centre - Sussex Room

Chair: J.P.M. Hoefnagels, *Eindhoven University Of Technology The Netherlands*

- 10:30 T10.011 **Elastic Field of an Elliptical Inhomogeneity with Polynomial Eigenstrains in Orthotropic Media**  
G.H. Nie\*, C.K. Chan  
*Tongji University, Shanghai, China*
- 10:50 T10.012 **Characterization and Modeling of Ductile Rupture with Relationship of Microstructures in 2198 Al-Li Alloy for Aeronautic Application**  
J. Chen\*, J. Besson, Y. Madi  
*Centre Des Matériaux, Mines Paristech, CNRS UMR7633, Evry, France*
- 11:10 T10.021 **Mechanics of Growth and Coalescence of Preexisting Voids**  
T. Jodlowski\*, J. Giovanola  
*École Polytechnique Fédérale, Lausanne, Switzerland*
- 11:30 T10.014 **Damage and Fracture Mechanisms in Ti-LCB and Ti555 Alloys : Micromechanical Testing and Modelling**  
P. Dufour\*, N. Clément, A. Lenain, T. Pardoën, P.J. Jacques  
*Université catholique de Louvain, Louvain-la-Neuve, Belgium*
- 11:50 T10.015 **Strain Localization Analysis Deduced from a Large Strain Elastic-Plastic Self-Consistent Model for Multiphase Steels**  
G. Franz\*, F. Abed-Meraim, T. Ben Zineb, X. Lemoine, M. Berveiller  
*LPMM, UMR CNRS 7554, ENSAM ParisTech, Metz, France*

**T10-S4**

Tuesday July 14, 15:30 – 17:10

Conference Centre - Sussex Room

Chair: G. Borino, *University of Palermo, Italy*

- 15:30 T10.016 **Effect of the Lode Parameter on Ductile Fracture**  
X. Gao\*, T. Zhang, C. Roe, M. Hayden  
*University of Akron, Akron, USA*
- 15:50 T10.017 **A Study of the Cluster Effect on Fatigue Crack Initiation**  
Y. Guilhem\*, G. Cailletaud, S. Basseville, F. Curtit, J.M. Stéphan  
*Centre des Matériaux, Mines-ParisTech, CNRS UMR7633, Evry, France*
- 16:10 T10.018 **Comparison of Quantitative Damage Characterization Methodologies**  
J.P.M. Hoefnagels\*, C.C. Tasan, L.C.N. Louws, M.G.D. Geers  
*Eindhoven University Of Technology, Eindhoven, The Netherlands*
- 16:30 T10.019 **Non-Local Ductile Damage Implementation Using Three Field Low Order Tetrahedral Element**  
H.R. Javani Joni\*, R.H.J. Peerlings, M.G.D. Geers  
*M2i Materials Innovation Institute, Delft, The Netherlands*
- 16:50 T10.043 **Modelling Fracture in Open-cell Metal Foams**  
K.R. Mangipudi \*, P.R. Onck  
*University of Groningen, Groningen, The Netherlands*

**T10-S5****Wednesday July 15, 10:30 – 12:10**

Conference Centre - Sussex Room

Chair: J.E. Bozek, *Cornell University, USA*

- 10:30 T10.024 **Effect of Particle Size on Fracture Toughness of Polymer Composites**  
B. Lauke\*  
*Leibniz Institute of Polymer Research, Dresden, Germany*
- 10:50 T10.025 **The Role of Mg in Void Formation during Plastic Deformation of AA6016 Aluminium Alloys**  
O. Leon Garcia\*, R. Petrov, L.A.I. Kestens  
*Materials Innovation Institute, Delft, The Netherlands*
- 11:10 T10.026 **Damage of TWIP Steels for Automotive Application**  
J. Lorthios\*, A.F. Gourgues, P. Cugy, C. Scott  
*Centre Des Matériaux - ENSMP, Evry, France*
- 11:30 T10.027 **A Consistent Anisotropic Brittle Damage Model Based on Kinking Elliptical Microcracks**  
K. Molla-Abbasi\*, H. Schuette  
*Institute Of Mechanics, Ruhr University-Bochum, Germany*
- 11:50 T10.028 **Experimental and Computational Analysis of Toughness Anisotropy in an AA2139 Al-Alloy for Aerospace Applications**  
T.F. Morgeneyer\*, J. Besson, H. Proudhon, M.J. Starink, I. Sinclair  
*Centre Des Matériaux, CNRS UMR 7633, Mines Paris, ParisTech, Evry, France*

**T10-S6****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Sussex Room

Chair: J. Lorthios, *Centre Des Matériaux - ENSMP, France*

- 13:30 T10.030 **Multiscale Modeling of the Competition between Intergranular and Transgranular Ductile Fracture in Al Alloys**  
T. Pardoen\*, P.R. Onck, Y. Bréchet, F. Scheyvaerts  
*Université catholique de Louvain, France*
- 13:50 T10.031 **Damage Measurements after Creep Tests on Samples of HP-40 Alloys Modified with a Low Level Addition of Nb**  
D. Poquillon\*, R. Voicu, J. Lacaze, E. Andrieu, J. Furtado  
*CIRIMAT, Toulouse, France*
- 14:10 T10.032 **Stress Distribution in Carbides of Spheroidised Steel Using a Polycrystalline Modeling**  
S. Rezaee\*, C. Berdin  
*École Centrale Paris, L.MSSMat, CNRS UMR 8579, France*
- 14:30 T10.033 **Modelling and Numerical Simulation of Orthogonal Metal Cutting by Chip Formation and Breaking Using Thermo-Elasto-Visco-Plastic Constitutive Equations Fully Coupled with Ductile Damage**  
K. Saanouni\*, C. Labergère, M. Issa, A. Rassineux  
*ICD/LASMIS, FRE 2848 CNRS, University of Technology, Troyes, France*
- 14:50 T10.034 **Influence of Slip Localization on Crack Initiation at the Grain Scale**  
M. Sauzay\*  
*CEA Saclay, DEN-DMN-SRMA, Gif-sur-Yvette, France*

**T10-S7****Wednesday July 15, 15:30 – 17:10**

Conference Centre - Sussex Room

Chair: R. Souchet, *Association Française de Mécanique, France*

- 15:30 T10.036 **Mechanistic Study of Delamination Fracture in Al-Li Alloy C458 (2099)**  
W.A. Tayon\*, R.E. Crooks, M.S. Domack, J.A. Wagner, A.J. Beaudoin, R.J. McDonald  
*Old Dominion University, Norfolk, Virginia, USA*
- 15:50 T10.037 **A Micromechanics Based Model for Ductile Damage in Multiphase and Composite Metallic Alloys Combining Extended Gurson and Homogenization Theory**  
C. Tekoglu\*, T. Pardoen  
*Université Catholique De Louvain, Louvain-la-Neuve, Belgium*
- 16:10 T10.038 **A Multi-Scale Methodology to Model Damage, Deformation and Ignition of Highly-Filled Energetic Materials**  
G. Vivier\*, F. Hild, H. Trumel  
*LMT Cachan (UMR CNRS 8535), ENS Cachan/CNRS/University Paris 6/PRES UniverSud, Cachan, France*
- 16:30 T10.022 **A Micromechanics-based Ductile Damage Model Incorporating Plastic Anisotropy and Void Shape Effects**  
S.M. Keralavarma\*, A.A. Benzerga  
*Texas A & M University, College Station, USA*
- 16:50 T10.020 **Assessment of Load History Effects on Ductile Initiation Fracture Toughness by the Gurson-Tvergaard-Needleman Model**  
A.P. Jivkov\*, J.K. Sharples, P.J. Budden  
*Serco, Risley, Warrington, UK*

**T10-S8****Thursday July 16, 10:30 – 11:50**

Conference Centre - Sussex Room

Chair: S.M. Keralavarma, *Texas A & M University, USA*

- 10:30 T10.041 **Plastic Strain Hardening Effect on Ductile Fracture Resistance**  
Z.L. Zhang\*, P.A. Eikrem, E. Østby, B. Nyhus  
*Norwegian University Of Science And Technology, Trondheim, Norway*
- 10:50 T10.023 **Anisotropic and Unilateral Damage. Application to Concrete**  
O. Belaidi\*, Y. Labadi, N.E. Hannachi  
*CFAI Aube, Rosières Près Troyes, France*
- 11:10 T10.035 **Explicit Use of the Matrix Yield Condition for Restricting Damage-Plasticity in Porous Materials**  
R. Souchet\*  
*Association Française de Mécanique, Paris, France*
- 11:30 T10.029 **Modelling the Anisotropic Damage Behaviour of Highly-Filled Particulate Composites via a Multi-Scale Morphological Approach"**  
C. Nadot-Martin\*, S. Dartois, D. Halm, A. Dragon, A. Fanget, M. Gueguen  
*Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Futuroscope Chasseneuil, France*

**T11-S1****Monday July 13, 15:30 – 16:30**

Westin Hotel - Conferedation II Room

Chair: R. Jones, *Monash University, Australia*

- 15:30 T11.002 **A Whole-Structure Approach to the Influence of Residual Stress on Fracture**  
C.J. Aird\*, D.J. Smith  
*University Of Bristol, UK*
- 15:50 T11.029 **Fractographic Analysis of the Effects of Combined Natural Weathering and Seawater on the Performance of GFRE Pipes**  
N. Merah\*, S. Nizamuddin, Z. Khan, F. Al-Sulaiman, M. Mehdi  
*King Fahd University Of Petroleum And Minerals, Dhahran, Saudi Arabia*
- 16:10 T11.006 **3D Crack Network during the Scratching of a Polymer: Comparison between Experimental Results and Localised Multigrid X-FEM**  
M.-C. Baietto-Dubourg\*, J. Rannou, A. Gravouil, H. Pelletier, C. Gauthier, R. Schirrer  
*LaMCoS CNRS, UMR5259 , Villeurbanne, France*

**T11-S2****Tuesday July 14, 10:30 – 11:50**

Westin Hotel - Conferedation II Room

Chair: M. Gao, *Blade Energy Partners , USA*

- 10:30 T11.007 **Diagnostics Cracks in Gears with Wavelet Analysis**  
A. Belsak\*, J. Flaker  
*University Of Maribor, Maribor, Slovenia*
- 10:50 T11.008 **Failure Behaviour of Textile Reinforced Thermoplastic Composites Made of Hybrid Yarns - I: Probabilistically Based Damage Models**  
R. Boehm\*, M. Gude, W. Hufenbach, M. Thieme  
*Technische Universität Dresden, Germany*
- 11:10 T11.009 **Mechanism of Damage, Fracture and Toughening of TiAl Alloys**  
R. Cao\*, J.H. Chen  
*State Key Laboratory of Advanced Non-Ferrous Metal Materials, Lanzhou University Of Technology, Lanz, China*
- 11:30 T11.012 **Examination of Fatigue Crack Origins in Aircraft Turbine Blades Using Serial Sectioning Techniques**  
S. Dionne\*, T. Lang, J. Li  
*Transportation Safety Board of Canada, Ottawa, Canada*

**T11-S3****Tuesday July 14, 15:30 – 17:10**

Westin Hotel - Conferedation II Room

Chair: C.J. Aird, *University Of Bristol, UK*

- 15:30 T11.013 **Design Related Failure of Thermowells in Feed Gas Supply Downstream Pipeline**  
A. El-Batahgy\*, G. Fathy, M. Amin  
*Central Metallurgical RandD Institute, Cairo, Egypt*
- 15:50 T11.017 **Actual Processes and Researches at Eurocopter on Failure Investigation of Metallic and Composite Parts**  
E. Greco\*, J.P. Charles, O. Molinas  
*Eurocopter Stress Department, Marignane, France*
- 16:10 T11.015 **Hydrogen Induced Cracking Analysis of a Pressure Vessel Made of SA 516 Grade 70 Steel by the Use of Phased Array Technology**  
M. Farzam\*, P. Malekinejad, M. Khorashadizadeh  
*Petroleum University of Technology, Ahwaz, Iran*
- 16:30 T11.016 **Experimental and Numerical Investigation on Fatigue Failure of Composite Helicopter Main Rotor Hub**  
M. Giglio\*, A. Manes, F. Viganò  
*Politecnico Di Milano, Italy*
- 16:50 T11.018 **A Study of Fracture Features and Fracture Toughness on CT Tests with Some Structural Glued-laminated Timber**  
W. Kambe\*, Y. Iijima  
*Institute of Wood Technology, Akita Prefectural University, Akita, Japan*

**T11-S4****Wednesday July 15, 10:30 – 12:10**

Westin Hotel - Conferedation II Room

Chair: S. Dionne, *Transportation Safety Board of Canada, Canada*

- 10:30 T11.019 **CZM Application to Failure Study of Brazed Joints: Parameters Determination**  
M. Karimi Ghovanlou\*, H. Jahed, A. Khajepour  
*University of Waterloo, Waterloo, Canada*
- 10:50 T11.036 **Numerical Study of Effects of Superimposed Pressure on Fracture**  
P.D.\* Wu, J.D. Embury, D.J. Lloyd  
*McMaster University, Hamilton, Canada*
- 11:10 T11.037 **Effect of Various Shearing Conditions on the Rod Shearing Quality for Large Nuts**  
G.Y. Tzou\*, T.M. Wu, M.Z. Yeh  
*Department of Mechanical and Automation Engineering, Kao-Yuan University, Kaohsiung, Taiwan*
- 11:30 T11.022 **The Intensity of Singularity of Residual Thermal Stresses at A Vertex in Three-Dimensional Bonded Structures**  
H. Koguchi\*, T. Taniguchi  
*Nagaoka University of Technology, Nagaoka, Japan*
- 11:50 T11.024 **Adhesively Bonded Joints Composed of Wooden Load-bearing Elements**  
M. Lehmann\*, T. Vallée, M. Brunner, T. Tannert  
*Bern University Of Applied Sciences, Biel, Switzerland*



**T11-S5****Thursday July 16, 10:30 – 11:50**

Westin Hotel - Conferedation II Room

Chair: A. Belsak, *University Of Maribor, Slovenia*

- 10:30 T11.025 **Interfacial Failure Mechanism of 316LSS Diffusion Bonded Joints**  
S.X. Li\*, F.Z. Xuan, S.T. Tu, S.R. Yu  
*Lanzhou University Of Technology, Lanzhou, China*
- 10:50 T11.028 **Cohesive Modeling of Ductile Dynamic Failure of Pressurized Metallic Structures**  
O.R. Van Der Meulen\*, J. Mediavialla Varas, J. Weerheijm, F. Soetens  
*TNO, Rijswijk, The Netherlands*
- 11:10 T11.035 **A Study of Crack Paths of Two-Dimensional Multi-Fibre Microcomposites**  
T. Zeng\*, D. Fang, S. Yang, Y. Guo  
*Harbin University Of Science And Technology, Harbin, China*
- 11:30 T11.030 **Investigation of Heat Affected and Phase Transformation of Soorbite to Troostite on Decreasing Fracture Toughness on Cold Rolls Steels**  
A.A. Mottahedi\*  
*Iranian Research Organization For Science and Technology (IROST), Tehran, Iran*

**T11-S6****Thursday July 16, 13:30 – 14:30**

Westin Hotel - Conferedation II Room

Chair: E. Greco, *Eurocopter Stress Department, France*

- 13:30 T11.032 **Failure Behaviour of Textile Reinforced Thermoplastic Composites Made of Hybrid Yarns - II: Experimental and Numerical Studies**  
M. Thieme\*, M. Gude, W. Hufenbach, R. Boehm  
*Technische Universität Dresden, Germany*
- 13:50 T11.033 **Failure Investigations of Cracked Spherical Bearings in Aircraft**  
X. Wu\*, A. Bourgeois  
*Bombardier Inc., Montréal, Canada*
- 14:10 T11.034 **Damage Calculations in Whole Evolving Process Actualized for the Materials Behaviors of Structure with Cracks to Use Software Technique**  
Y. Yangui\*, L. Zhihua, P. Yuelong, X. Feng, M. Yanghui  
*Zhejiang GuangXin New Technology Application Academy Of Electromechanical And Chemical Engineering, China*

**T12-S1 - Modelling****Monday July 13, 10:30 – 12:10**

Westin Hotel - Confederation I Room

Chair: D. Nowell, *University of Oxford, UK*

- 10:30 T12.017 **Keynote Presentation**  
**A Generalized Dimensional Analysis Approach to Fatigue Crack Growth**  
 M. Ciavarella\*, M. Paggi, A. Carpinteri  
*Politecnico di Bari, Bari, Italy*
- 11:10 T12.014 **Effect of Plastic Deformation of Artificial Wedges on Fatigue Crack Closure**  
 D.L. Chen\*  
*Ryerson University, Toronto, Canada*
- 11:30 T12.012 **Dissipation and Mean Stress Effect in HCF and LCF**  
 E. Charkaluk\*, A. Constantinescu  
*UMR CNRS 8107, École Centrale de Lille, Villeneuve d'Ascq, France*
- 11:50 T12.032 **Fatigue Crack Propagation in Two Dimensional Lattice Spring Models**  
 T.M. Guozden\*, E.A. Jagla  
*Instituto Balseiro - CNEA, Bariloche, Argentina*

**T12-S2 - Stainless****Monday July 13, 10:30 – 12:10**

Westin Hotel - Confederation III Room

Chair: T. Meshii, *Toshiyuki University of Fukui, JAPAN*

- 10:30 T12.016 **Effect of Deformation-Induced Martensite on the Fatigue Behavior of Metastable Austenitic Stainless Steels**  
 H.-J. Christ\*, U. Krupp, C. Mueller-Bollenhagen, I. Roth, M. Zimmermann  
*Universitaet Siegen, Siegen, Germany*
- 10:50 T12.021 **Fatigue Strength and Fracture Surface Morphology in Ultra-Fine Grained Ferritic Stainless Steels**  
 R. Ebara\*, Y. Matsumura, K. Kishi, Y. Ishibashi  
*Hiroshima Institute Of Technology, Hiroshima, Japan*
- 11:10 T12.069 **Thermomechanical Fatigue Behavior and Lifetime Prediction of Niobium-Added Ferritic Stainless Steel**  
 Y.J. Oh\*, W.D. Choi, J.G. Jung, W.J. Yang  
*Hanbat University, Daejeon, South Korea*
- 11:30 T12.097 **Slip Localization and Dislocation Structure at Early Stages of Fatigue Damage in Austenitic Stainless Steel (316L)**  
 A. Weidner\*, J. Man, W. Skrotzki, J. Polak  
*Technische Universität Dresden, Institute Of Structural Physics, Dresden, Germany*
- 11:50 T12.096 **Effect of Short Crack on Closure Behavior in a 304L Austenitic Stainless Steel**  
 K. Vor\*, C. Sarrazin-Baudoux, C. Gardin, J. Petit  
*LMPM, UMR CNRS 6617, ENSMA, Chasseneuil du Poitou, France*

**T12-S3 - Short Cracks 1****Monday July 13, 15:30 – 17:10**

Westin Hotel - Confederation I Room

Chair: P.A.S. Reed, *University Of Southampton, UK*

- 15:30 T12.025 **Small Fatigue Crack Growth under In-phase and Out-of-phase Combined Loading**  
M. Endo\*, S. Ikeda, A.J. McEvily  
*Fukuoka University, Fukuoka, Japan*
- 15:50 T12.067 **Analysis of Short Crack Growth for Two Representative Light Metals**  
A. Leitgeb\*, C. Oberwinkler, H. Leitner, S. Redik, B. Oberwinkler  
*University Of Leoben, Institute Of Mechanical Engineering, Leoben, Austria*
- 16:10 T12.077 **Effect of Mean Stress on Short Crack Growth and Fatigue Life in Austenitic-Ferritic Duplex Steel**  
J. Polák\*, M. Petrevec, K. Obrtlík  
*Institute of Physics of Materials, Academy Sciences of the Czech Republic, Brno, Czech Republic*
- 16:30 T12.105 **3D Analysis of Short Fatigue Crack Propagation in a Beta Ti alloy: Effect of the Local Crystallographic Orientation**  
M. Herbig\*, J.-Y. Buffiere, W. Ludwig, E.M. Lauridsen, A. King, G. Johnson  
*Université de Lyon, Lyon, France*
- 16:50 T12.095 **Short Cracks at Notches and Fatigue Life Prediction under Mode I and Mode III Loadings**  
Y. Verreman\*, H. Guo  
*École Polytechnique de Montréal, Canada*

**T12-S4 - Steels 1****Monday July 13, 15:30 – 17:10**

Westin Hotel - Confederation III Room

Chair: F. Morel, *Arts et Métiers ParisTech, France*

- 15:30 T12.005 **Cyclic Fracture Behaviour of Brazed Martensitic Stainless Steel Joints**  
H.-J. Schindler\*, C. Leinenbach, T.A. Baser  
*EMPA, Swiss Federal Laboratories For Materials Testing And Research, Dübendorf, Switzerland*
- 15:50 T12.004 **Effect of Surface Finish on Fatigue of Stainless Steels**  
S. Al-Shahrani\*, T.J. Marrow  
*University Of Manchester, UK*
- 16:10 T12.022 **Fatigue Life Calculation of Metastable Austenitic Steels**  
M. Smaga\*, D. Eifler, F. Walther  
*Institute Of Materials Science And Engineering, University Of Kaiserslautern, Germany*
- 16:30 T12.011 **Fatigue Crack Branching Behavior in Dual Phase Material**  
S. Johansson\*, R.L. Peng, K. Slamecka, G. Chai  
*Sandvik Materials Technology, Sandviken, Sweden*
- 16:50 T12.027 **Predicting Fatigue Lives of Carburized Steels Based on Residual Stress Profiles and Microstructural Influences**  
K.O. Findley\*, G. Krauss, D.K. Matlock  
*Colorado School of Mines, Golden, USA*

**T12-S5 - Short Cracks 2**

Tuesday July 14, 10:30 12:10

Westin Hotel - Confederation I Room

Chair: Y. Verreman, *Ecole Polytechnique de Montréal, Canada*

- 10:30 T12.008 **3D Characterisation of Short Fatigue Crack in Ti 6246**  
S. Biroasca\*, F.A. Garcia-Pastor, M. Karadge, J.Y. Buffiere, M. Preuss  
*University Of Manchester, UK*
- 10:50 T12.061 **Short Crack and Near Threshold Fatigue Behaviour of Al Casting Alloys**  
P.A.S. Reed\*, B.G. Mellor, I. Sinclair, A.J. Moffat  
*University Of Southampton, Southampton, UK*
- 11:10 T12.031 **Analysis of Shot Peening Influence on Short Crack Fatigue Threshold of Nitrided Steels**  
M. Guagliano\*, I. Fernández Pariente, S. Bagheri Fard  
*Politecnico di Milano, Milan, Italy*
- 11:30 T12.044 **Simulation of Stage I Short Crack Propagation in an Austenitic-Ferritic Duplex Steel**  
P. Köster\*, H. Knobbe, U. Krupp, C.-P. Fritzen, H.-J. Christ  
*Institute for Mechanics and Control - Mechatronics, University of Siegen, Siegen, Germany*
- 11:50 T12.058 **Influence of Microstructural Barriers on Short Fatigue Crack Growth**  
M. Marx\*, W. Schäf, H. Vehoff  
*Saarland University, Saarbrücken, Germany*

**T12-S6 - Steels 2**

Tuesday July 14, 10:30 - 12:10

Westin Hotel - Confederation III Room

Chair: R.I. Stephens, *University of Iowa, USA*

- 10:30 T12.102 **In-Situ Fatigue Test of A36-Steel**  
K. Yamagiwa\*, D.W. Hoepfner  
*National Institute For Occupational Safety And Health, Tokyo, Japan*
- 10:50 T12.068 **Effect of Tempering Temperature on Very High Cycle Fatigue Properties of High Strength Steel**  
H. Oguma\*, T. Nakamura  
*Hokkaido University, Sapporo, Japan*
- 11:10 T12.002 **Fatigue Resistance of Hot-Dip Galvanized Hot-Rolled and High-Silica TRIP Steel**  
S. Aden-Ali\*, A. Chamat, J. Gilgert, E. Petit, S. Dominiak, L. Schmitt, M. Gilles, Z. Azari  
*ENIM-LFM, Metz, France*
- 11:30 T12.073 **Anisotropic High Cycle Fatigue Behavior and Related Crack Initiation Mechanisms in Forged Steel**  
E. Pessard\*, F. Morel, A. Morel, D. Bellett  
*Arts et Métiers ParisTech, Angers, France*
- 11:50 T12.003 **On Some Trends Associated with Stage II Fatigue Crack Growth Behavior of Metals**  
T.M. Ahmed\*, D. Tromans  
*Ionik Consulting/JP Kenny Inc., Houston, USA*

**T12-S7 - Multiaxial**

Tuesday July 14, 15:30 – 17:10

Westin Hotel - Confederation I Room

Chair: F. Ellyin, *University Of British Columbia, Canada*

- 15:30 T12.028 **A Modified Approach for Multiaxial Fatigue Damage Prediction**  
A. Ganjidoost\*, M. Shariyat  
*K.N. Toosi University Of Technology, Tehran, Iran*
- 15:50 T12.036 **Evaluation of Local Stress and Strain State at Notch Root by Means of a New Method Valid for Multiaxial Random Loadings**  
T. Herbland\*, G. Cailletaud, S. Quilici  
*Cetim, Senlis, France*
- 16:10 T12.052 **Crack Growth-Based Multiaxial Fatigue Life Prediction**  
Z. Lu\*, Y. Liu  
*Clarkson University, Potsdam, USA*
- 16:30 T12.062 **Fatigue from Defect: Experiments and Multiaxial Criterion**  
Y. Nadot\*  
*LMPM - ENSMA, Futuroscope Chasseneuil, France*
- 16:50 T12.045 **Effect of High Hydrostatic Stress on the Fatigue Behaviour of Metallic Materials**  
I. Koutiri\*, D. Bellett, F. Morel, L. Augustins  
*Arts et Métiers ParisTech, Angers, France*

**T12-S8 - Al and Light**

Tuesday July 14, 15:30 – 16:50

Westin Hotel - Confederation III Room

Chair: W. Beres, *National Research Council Canada, IAR, Canada*

- 15:30 T12.037 **Fatigue Cracking Behavior in Aluminum 7050**  
M.H. Huang\*, J.A. Szpunar, M. Liao  
*McGill University, Montréal, Canada*
- 15:50 T12.047 **The influence of Ageing on Fatigue and Fracture Related Material Parameters for an Aluminum Cast Alloy**  
A. Leitgeb\*, H.-P. Gaenser, R. Ehart, J. Fröschl, W. Eichlseder  
*Christian Doppler Laboratory for Fatigue Analysis, Leoben, Austria*
- 16:10 T12.094 **Effect of Friction Stir Processing on the Fatigue Behaviour of Cast Aluminium Alloy**  
Y. Uematsu\*, K. Tokaji, Y. Tozaki, H. Shibata, K. Fujiwara, T. Murayama  
*Gifu University, Gifu, Japan*
- 16:30 T12.053 **Effects of Residual Stresses on Fatigue Crack Propagation in Friction Stir Welded 2198-T8 and 2195-T8 Al-Li alloy joints**  
Y.E. Ma\*, P.E. Irving, T. Fischer, X. Zhang, G. Servetti  
*School of Applied Science, Cranfield University, UK*

**T12-S9 - Load History****Wednesday July 15, 10:30 – 12:10**

Westin Hotel - Confederation I Room

Chair: M. Ciavarella, *Politecnico di Bari, Italy*

- 10:30 T12.089 **Development of Crack Growth Rate at Multiple Overloads**  
J. Steinbock\*, H.-J. Gudladt  
*Bundeswehr University, Munich, Germany*
- 10:50 T12.072 **Some Considerations on the Prediction of Fatigue Crack Growth Retardation in Structural Materials**  
M.V. Pereira\*, F.A. Darwish, A.F. Camarão, S.H. Motta  
*Catholic University of Rio de Janeiro, Brazil*
- 11:10 T12.085 **Experimental Estimation of Fatigue Crack Growth Rate and Study of Stress Ratio Effect in Thin Aluminium Alloy Plates**  
A.R. Shahani\*, H. Moayeri Kashani, M. Rastegar, M. Botshekanan Dehkordi  
*K.N. Toosi University Of Technology, Tehran, Iran*
- 11:30 T12.071 **Cohesive Fracture Modelling of Overload Effects in Fatigue**  
K.D. Papoulia\*, V.R. Krishnan  
*Cornell University, Ithaca, USA*
- 11:50 T12.043 **Effects of Earthquake Loads and Absorbed Hydrogen on the Fatigue Strength Reduction of Notched Component**  
Y. Kondo\*, T. Yamanouchi  
*Kyushu University, Fukuoka, Japan*

**T12-S10 - Composites****Wednesday July 15, 10:30 – 12:10**

Westin Hotel - Confederation III Room

Chair: A. Plumtree, *University of Waterloo, Canada*

- 10:30 T12.015 **A Damage Examination Method by C-Scan on CFRP Laminate**  
H.S. Chen\*, W.C. Chen, S.F. Hwang  
*National Formosa University, Huwei Township, Yunlin County, Taiwan*
- 10:50 T12.018 **High-Cycle Fatigue Behaviour of a Pultruded Composite Material Used in Structural Applications**  
M. Guagliano\*, C. Colombo, L. Vergani  
*Politecnico di Milano, Italy*
- 11:10 T12.024 **On the Concept of Fatigue Crack Arrest by Bonding a Composite Patch**  
F. Ellyin\*  
*University Of British Columbia, Vancouver, Canada*
- 11:30 T12.075 **Fatigue Behavior of Vinyl Ester Polymer and Effects of Carbon Nanofiber Reinforcement**  
A. Plaseied\*, A. Fatemi  
*University of Colorado, Boulder, USA*
- 11:50 T12.083 **The Influence of Temperature on Crack Growth in Fibre Metal Laminates**  
C.D. Rans\*, R.C. Alderliesten  
*Delft University of Technology, Delft, The Netherlands*

**T12-S11 - Applications 1****Thursday July 16, 10:30 – 11:50**

Westin Hotel - Confederation I Room

Chair: C.D. Rans, *Delft University of Technology, The Netherlands*

- 10:30 T12.048 **Fatigue Life Assessment of a Novel Mobile Phone Hinge**  
K.-C. Liao\*, W.-C. Lin  
*National Taiwan University, Taipei, Taiwan*
- 10:50 T12.020 **Replacement Decision of Bridge Girder of a Working EOT Crane Based on Fatigue Life Calculation**  
S.K. Dhagat\*, P.V. Joshi, M.D. Gnanavel  
*SSCET Junwani, Bhilai, Chhattisgarh, India*
- 11:10 T12.038 **Numerical Study on Reducing Methods of Static Strain Along the Fillet on Upper Deck of Diesel Engine Cylinder Block**  
K. Iguchi\*, N. Tada, I. Shimizu, K. Iwasaki  
*Yanmar Co., Ltd, Amagasaki, Hyogo, Japan*
- 11:30 T12.056 **In-situ Observation of Damage Mechanisms by Digital Image Correlation during Tension and Low Cycle Fatigue of Magnesium Alloys**  
T.J. Marrow\*, A.A. Khan  
*Pakistan Institute of Nuclear Science and Technology, Pakistan*

**T12-S12 - Temperature****Thursday July 16, 10:30 – 12:10**

Westin Hotel - Confederation III Room

Chair: C. Guster, *Polymer Competence Center Leoben GmbH, Austria*

- 10:30 T12.042 **High-Cycle Fatigue Properties of Ni-Based Alloy718 and Iron-Based A286 Superalloys at Elevated-Temperature**  
K. Kobayashi\*, M. Hayakawa, M. Kimura  
*National Institute for Materials Science, Tsukuba, Japan*
- 10:50 T12.050 **High-Temperature Fatigue Crack Growth Behavior of 17-4 PH Stainless Steels at Various Load Ratios**  
C.-K. Lin\*, K.-C. Hsu  
*National Central University, Jhong-Li, Taiwan*
- 11:10 T12.104 **Mechanisms of Fatigue Failure of Nickel-Base Alloys at Room and Elevated Temperatures in the Very High Cycle Regime**  
M. Zimmermann\*, C. Stoecker, H.-J. Christ  
*Universitaet Siegen, Siegen, Germany*
- 11:30 T12.103 **Isothermal and Thermomechanical Fatigue Behaviour of IN738LC**  
S. Yandt\*, D.Y. Seo, P. Au, J. Beddoes  
*National Research Council Canada, Institute for Aerospace Research, Ottawa, Canada*
- 11:50 T12.055 **Surface Relief Evolution in 316L Steel Fatigued at Depressed and Elevated Temperatures**  
J. Man\*, M. Petre nec, P. Klapetek, K. Obrtlík, J. Polak  
*IPM ASCR, Brno, Czech Republic*

**T12-S13 - Applications 2****Thursday July 16, 13:30 – 15:10**

Westin Hotel - Confederation I Room

Chair: T.J. Marrow, *Pakistan Institute of Nuclear Science and Technology, Pakistan*

- 13:30 T12.023 **Effective Strain-Fatigue Life of Dual Phase 590 Steel**  
M. El Zeghayar\*, T. Topper, J. Bonnen, R. Sohmshtetty  
*University Of Waterloo, Waterloo, Canada*
- 13:50 T12.057 **Fatigue Behaviour of DLC Coated Die Material**  
K. Maruchi\*, Y. Uematsu, K. Tokaji  
*Gifu University, Gifu, Japan*
- 14:10 T12.078 **Fatigue Analysis of Large Slewing Bearing Using Strain-Life Approach**  
R. Potocnik\*, J. Flasker, S. Glodez  
*University Of Maribor, Slovenia*
- 14:30 T12.010 **Fatigue of Stiffened Panels with Multiple Interacting Cracks - An Experimental and Numerical Simulation Analysis**  
Z. Bozic\*, H. Wolf, D. Semenski, V. Bitunjac  
*University of Zagreb, Croatia*
- 14:50 T12.006 **Fatigue Crack Growth Rate Evaluation in a Turbine Disc after Spin Rig Testing**  
W. Beres\*, D. Dudzinski, A. Murzionak  
*National Research Council Canada, Institute for Aerospace Research, Ottawa, Canada*

**T12-S14 - Creep****Thursday July 16, 13:30 – 15:10**

Westin Hotel - Confederation III Room

Chair: C. Acevedo, *Swiss Federal Institute Of Technology, Switzerland*

- 13:30 T12.084 **Crack Growth Rate Behaviour and Microstructural Features of Incoloy 800H under Fatigue and Creep-Fatigue Conditions**  
D.Y. Seo\*, J. Tsang, R. Kearsey, W.J. Yang, K.S. Cho, J.H. Lee, P. Au  
*National Research Council Canada, Institute for Aerospace Research, Ottawa, Canada*
- 13:50 T12.035 **Characterization of Subgrains for Ferritic Heat-Resisting Steels with Different Creep-Fatigue Susceptibility**  
M. Hayakawa\*, M. Kimura, K. Kobayashi  
*National Institute for Materials Science, Tsukuba, Ibaraki, Japan*
- 14:10 T12.026 **Fracture Mechanisms due to Fatigue, Creep and Environmental Damage in Titanium Alloys**  
W.J. Evans\*, M.T. Whittaker, W. Harrison  
*Swansea University, Swansea, UK*
- 14:30 T12.093 **Dwell-Fatigue Life of a Near-Alpha Titanium Alloy and Ultrasonic Measurement Correlation**  
L. Toubal\*, P. Bocher, A. Moreau  
*École de Technologie Supérieure, Montréal, Canada*
- 14:50 T12.098 **Time Dependent Fatigue Fractures of Titanium Alloys**  
W.J. Evans\*, M.T. Whittaker, W. Harrison  
*Swansea University, Swansea, UK*



**T12-S16 - Initiation****Thursday July 16, 15:30 – 17:10**

Westin Hotel - Confederation III Room

Chair: F. Berto, *University of Padova, Italy*

- 15:30 T12.039 **On the Early Initiation of Fatigue Cracks in the High Cycle Regime**  
S. Ishihara\*, A.J. McEvily  
*University of Toyama, Toyama, Japan*
- 15:50 T12.019 **Evaluation of the Effect of Surface Roughness on Crack Initiation Life**  
G. Deng\*, K. Nagamoto, Y. Nakano, T. Nakanishi  
*University of Miyazaki, Japan*
- 16:10 T12.063 **Decrease in Fatigue Crack Initiation Life by Irreversible Hydrogen in Cold Drawn Eutectoid Steel**  
M. Nakatani\*, M. Sakihara, K. Minoshima  
*Osaka University, Suita, Osaka, Japan*
- 16:30 T12.074 **The Effect of Microstructure on Fatigue Crack Initiation in Ti-6Al-4V**  
A.L. Pilchak\*, A. Bhattacharjee, R.E.A. Williams, J.C. Williams  
*Ohio State University, Columbus, USA*
- 16:50 T12.029 **Lifetime Modelling of Fatigue Crack Initiation from Casting Defects**  
M. Geuffrard\*, L. Rémy, A. Köster  
*Centre des Matériaux, Mines, ParisTech, CNRS UMR 7633, France*

**T12-S17 - Welding****Friday July 17, 10:30 – 12:10**

Westin Hotel – Governor General II Room

Chair: Z. Bozic, *University of Zagreb, Croatia*

- 10:30 T12.001 **Residual Stress Estimation of Welded Tubular K-joints under Fatigue Loads**  
C. Acevedo\*, A. Nussbaumer  
*Swiss Federal Institute Of Technology, Lausanne, Switzerland*
- 10:50 T12.007 **Practical Advantages of the Local Strain Energy Approach for Fatigue Strength Assessments of Welded Joints**  
F. Berto\*, P. Lazzarin, F.J. Gomez, M. Zappalorto  
*University of Padova, Vicenza, Italy*
- 11:10 T12.013 **Stress Analysis and Fatigue of Weldments**  
A.B. Chattopadhyay\*, G. Glinka, S. Malik  
*University of Waterloo, Waterloo, Canada*
- 11:30 T12.040 **Estimating the Fatigue Behaviour of Welded Joints**  
L.F. Jaureguizar\*, M.D. Chapetti  
*University of Mar Del Plata, Argentina*
- 11:50 T12.064 **Strength Evaluation of Spot Weld in Fatigue Using Double-Cup Specimen**  
E. Nakayama\*, M. Miyahara, H. Fujimoto, Y. Hirose, K. Fukui, T. Kitamura  
*Sumitomo Metal Industries, Ltd, Hyogo, Japan*

**T12-S18 - General****Friday July 17, 10:30 – 12:10**

Westin Hotel - Confederation III Room

Chair: K. Kobayashi, *National Institute for Materials Science, Japan*

- 10:30 T12.041 **Fatigue Life of Components with Two Types of Defects**  
K. Karlén\*, M. Olsson, G. Härkegård  
*Royal Institute of Technology (KTH), Stockholm, Sweden*
- 10:50 T12.046 **Understanding Crack Size Effects during Fatigue of Extrinsicly Toughened Materials**  
J.J. Kruzic\*  
*Oregon State University, Corvallis, OR, USA*
- 11:10 T12.081 **Fatigue Crack Growth Resistance of Nanocrystalline Copper**  
R.K. Rajgarhia\*, C. Jackson, A. Saxena  
*University of Arkansas, Fayetteville, USA*
- 11:30 T12.070 **Influence of Grain Size and Aging on Fatigue Behavior of AZ-type Magnesium Alloys**  
N. Ono\*, Y. Nishimura  
*Sojo University, Kumamoto, Japan*
- 11:50 T12.100 **Damping of Flexible Structures with PEO Coating**  
C.X. Wong\*, D. Asquith, Y.H. Tai, A.L. Yerokhin, J.A. Rongong, J.R. Yates  
*University of Sheffield, UK*

**T12-S19 - Experimental Mechanics****Wednesday July 15, 13:30 – 15:10**

Westin Hotel - Governor General III Room

Chair: K.J. Cain, *Conestoga College, Canada*

- 13:30 T12.049 **Three-Dimensional Study of Fatigue Crack Propagation Using Synchrotron X-ray Microtomography**  
N. Limodin\*, J.Y. Buffiere, J. Rethore, F. Hild, S. Roux, W. Ludwig  
*INSA de Lyon, Villeurbanne, France;*
- 13:50 T12.082 **Study of Crack Propagation by Infrared Thermography During Very High Cycle Fatigue Regime**  
N. Ranc\*, D. Wagner, L. Illoul, P.C. Paris, C. Bathias  
*LMSP Arts Et Métiers Paris Tech, Paris, France*
- 14:10 T12.087 **Low Cycle Fatigue Behaviour of Extruded Magnesium Alloys**  
K. Shiozawa\*, M. Nagai, T. Kaminashi  
*University of Toyama, Toyama, Japan*
- 14:30 T12.030 **Experimental Evaluation of Stress Intensity Factors along Three Dimensional Crack Fronts during Fatigue Tests**  
A. Gravouil\*, J. Réthoré, N. Limodin, J.-Y. Buffiere, F. Hild, S. Roux  
*LaMCoS / INSA Lyon, Villeurbanne, France*
- 14:50 T12.080 **In situ Three Dimensional Monitoring and Modelling of Small Corners Cracks in Airframe Al-Alloys**  
H. Proudhon\*, A.J. Moffat, I. Sinclair, J.-Y. Buffiere  
*Mines Paris, Paristech, Paris, France*

**T12-S20 - Surface Effects**

Wednesday July 15, 15:30 – 17:10

Westin Hotel - Governor General III Room

Chair: W.J. Evans, *Swansea University, UK*

- 15:30 T12.086 **Observation of Fretting Fatigue Cracks by Micro Computed Tomography with Synchrotron Radiation**  
D. Shiozawa\*, Y. Nakai, T. Kurimura, K. Kajiwara  
*Kobe University, Kobe, Japan*
- 15:50 T12.059 **Quantitative and Qualitative Study on the Cracking in Ti-6Al-4V Material under Fretting-Fatigue Solicitations**  
J. Meriaux\*, S. Fouvry, K. Kubiak, J-A. Ruiz-Sabariego, B. Bonnet  
*LTDS, Ecole Centrale de Lyon, Ecully, France*
- 16:10 T12.090 **Effect of Shot and Laser-Peening on SAE 1010 Steel Tubes with a Transverse Center Weld Subjected to Constant and Variable Amplitude Loading**  
R.I. Stephens\*, L.D. Vo  
*University of Iowa, Iowa City, USA*
- 16:30 T12.076 **Shot Peening Effects on Fatigue Life**  
A. Plumtree\*  
*University of Waterloo, Canada*
- 16:50 T12.091 **Fatigue Crack Growth Behavior of P/M Soft Magnetic Material with a High-resistance Surface Layer**  
R. Tanegashima\*, H. Akebono, M. Kato, A. Sugeta  
*Hiroshima University, Higashi-Hiroshima, Japan*

**T12-S21 - Environment**

Wednesday July 15, 15:30 – 17:10

Westin Hotel - Quebec Room

Chair: M. Zimmermann, *Universitaet Siegen, Germany*

- 15:30 T12.066 **Loading-Frequency Effects on Fatigue Crack Growth Behavior of a Low Carbon Steel in Hydrogen Gas Environment**  
H. Nishikawa\*, Y. Oda, H. Noguchi  
*Kyushu University, Fukuoka, Japan*
- 15:50 T12.060 **Assessment of Environmental Effect on the Closure-Free Threshold Stress Intensity Factor (SIF) Range**  
T. Meshii\*, M. Tsuji  
*University of Fukui, Japan*
- 16:10 T12.051 **Small Fatigue Crack Behavior and Life Prediction of Pre-Corroded 2024-T62 Aluminum Alloy**  
J.Z. Liu\*, X.B. Ye, C.F. Ding, B. Chen, B.R. Hu  
*Beijing Institute Of Aeronautical Materials, Beijing, China*
- 16:30 T12.033 **Effects of Temperature and Moisture on the Tensile/Tensile Fatigue Behavior of an Injection Molded sgf-Reinforced Partial Aromatic Polyamide**  
Ch. Guster\*, G. Pinter, W. Eichseder, R.W. Lang  
*Polymer Competence Center Leoben GmbH, Leoben, Austria*
- 16:50 T12.101 **Fatigue Life Prediction of Corroded Specimen**  
Y. Xiang\*, Y. Liu  
*Clarkson University, Potsdam, USA*

**T14-S1****Thursday July 16, 10:30 – 11:50**

Westin Hotel - Quebec Room

Chair: R. Goldstein, Russian Academy of Sciences, Russia

- 10:30 T14.001 **Crack and Delamination Risk Evaluation in low-k BEoL Stacks under Chip Package Interaction Aspects**  
J. Auersperg\*, D. Vogel, M.U. Lehr, M. Grillberger, B. Michel  
*Fraunhofer IZM Berlin and Fraunhofer ENAZ, Chemnitz, Germany*
- 10:50 T14.002 **Characterization of the Failure Behavior of Microelectronic Components under Dynamic Loading Conditions**  
P.F. Fuchs\*, Z. Major, R.W. Lang  
*Institute of Materials Science and Testing of Plastics, University of Leoben, Leoben, Austria*
- 11:10 T14.003 **Multi Scale Insights into Deformation/Environment Interaction Affecting the Mechanical Behavior**  
Y. Katz\*  
*Negba, Beer Sheva, Israel*
- 11:30 T14.004 **Detection and Analysis of Fracture Initiation and Strength in Microelectronic Packages Using Methods of Computer Vision and Fiber Bragg Grating**  
H. Lu\*  
*Ryerson University, Toronto, Canada*

**T14-S2****Thursday July 16, 13:30 – 14:50**

Westin Hotel - Quebec Room

Chair: J.G. Williams, *Imperial College, UK*

- 13:30 T14.007 **Fracture Modeling of Interface Junctions on the Base of Multiscale Crack Bridging Concept**  
M. Perelmutter\*  
*Institute for Problems in Mechanics of RAS, Moscow, Russia*
- 13:50 T14.008 **A Method to Improve the Reliability and the Life of Power Electronic Devices**  
S. Pommier \*, S. Pietranico, S. Lefebvre  
*LMT-Cachan (ENS Cachan/CNRS/Université Paris 6/UniverSud Paris), Cachan, France*
- 14:10 T14.009 **Determination of Copper/EMC Interface Fracture Toughness during Manufacturing, Moisture Preconditioning and Solder Reflow Process of Semiconductor Packages**  
M.H. Shirangi\*, W.H. Müller, B. Michel  
*MicroMaterials Center Berlin at Fraunhofer IZM, Berlin, Germany*
- 14:30 T14.010 **Study on the Effect of Moisture and Elevated Temperature on the Fracture Properties of Visco Elastic Polymers**  
H. Walter\*, H. Shirangi, E. Dermizaki, B. Wunderle, B. Michel  
*Fraunhofer IZM, Berlin, Germany*

**T14-S3**

**Thursday July 16, 15:30 – 16:50**

Westin Hotel - Quebec Room

Chair: S. Pommier, *LMT-Cachan (ENS Cachan/CNRS/Université Paris 6/UniverSud Paris), France*

- 15:30 T14.011 **MOVED TO T04-S3**
- 15:50 T14.012 **Fracture Behaviour of Cracked Functionally Graded Piezoelectric Materials (FGPMs)**  
Z. Yan\*, L.Y. Jiang  
*University of Western Ontario, London, Canada*
- 16:10 T14.005 **Fracture Toughness Measurement of Thin Nanoporous Films on Stiff Substrates**  
D.J. Morris\*, R.F. Cook  
*National Institute Of Standards And Technology, Gaithersburg, USA*
- 16:30 T14.006 **On the Mechanics of Buckling-Delamination in Compliant Laminates**  
R.H.J. Peerlings\*, E.D. Kleijne, E. Van Veenendaal, P.C.P. Bouten  
*Eindhoven University of Technology, Eindhoven, The Netherlands*

**T15-S1****Tuesday July 14, 10:30 – 12:30**

Conference Centre - Wellington Room

Chair: A.P.S. Selvadurai, *McGill University, Canada*

- 10:30 T15.006 **Keynote Presentation**  
**Supershear Rupture Propagation in a Monolithic Medium**  
K. Uenishi\*  
*Research Center for Urban Safety and Security, Kobe University, Kobe, Japan*
- 11:10 T15.005 **Fracture Initiation Toughness and Propagation Toughness of Laurentian Granite Rock**  
F. Lu\*, R. Chen, L. Lu, K. Xia  
*National University Of Defense Technology, Changsha, China*
- 11:30 T15.002 **On Fracture Mechanism of Granite Saturated with Water**  
E.E. Damaskinskaya\*, A.G. Kadomtsev, V.S. Kuksenko  
*Ioffe Physico-Technical Institute of the Russian Academy of Sciences, St. Petersburg, Russia*
- 11:50 T15.003 **A Hybrid FDM-BIEM Approach for Earthquake Dynamic Rupture Simulation**  
N. Kame\*, H. Aochi  
*Kyushu University, Fukuoka, Japan*
- 12:10 T15.004 **Basalt Columns and Crack Formation during Directional Drying of Colloidal Suspensions in Capillary Tubes**  
V. Lazarus\*, C. Maurini, C. Valdivia, G. Gauthier, L. Pauchard  
*UPMC Univ Paris 6, Univ Paris-Sud, CNRS, UMR 7608, Orsay, France*

**T16-S1****Tuesday July 14, 15:30 – 17:30**

Conference Centre - Gatineau Room

Chair: C. Rountree, CEA, IRAMIS, SPCSI, France

- 15:30 T16.001 **Densification of Glass Beneath an Indenter : Dependence of the Shape of the Deformed Zone on the Poisson's Ratio**  
N. Antonio-Tamarasselvame\*, M. Buisson, J-C. Sangleboeuf  
*Université De Rennes1-IRMAR-UMR 6625, France*
- 15:50 T16.002 **Glass Formation in Fe<sub>50-x</sub>Cr<sub>15</sub>Mo<sub>14</sub>C<sub>15</sub>B<sub>6</sub>M<sub>x</sub> (M= Y, Gd and x= 0,2) BulkMetallic Glasses**  
B. Bendjemil\*, A. Bouchareb, R. Piccin, M. Baricco  
*Università Di Torino, Torino, Italy*
- 16:10 T16.003 **Mechanical Effect of Capillary Forces in the Crack Tip of a DCDC Specimen**  
A. Grimaldi\*, M. George, G. Pallares, M. Ciccotti, L. Ponson  
*CNRS, University Montpellier 2, Montpellier, France*
- 16:30 T16.004 **Indentation Mechanical Characterization of Glasses: Role of Plastic Deformation-Induced Fictive Temperature Increase**  
M. Tomozawa\*, T. Gross  
*Rensselaer Polytechnic Institute, NY, USA*
- 16:50 T16.005 **Suitable Contact Materials for Axial Load Application into Glass Edges**  
B. Weller\*, S. Reich, J. Ebert  
*Technische Universität Dresden, Institute of Building Construction, Germany*
- 17:10 T16.006 **Evolution of the Fabric Tensor in Amorphous Silica: Via Molecular Dynamics Simulations**  
C.L. Rountree\*, M. Talamali, D. Vandembroucq, S. Roux, E. Bouchaud  
*CEA,IRAMIS,SPCSI, Gif-sur-Yvette, France*

**T17-S1****Thursday July 16, 10:30 – 12:10**

Westin Hotel - Governor General III Room

Chair: B. Fournier, *CEA Saclay, DEN/DANS/DMN/SRMA, France*

- 10:30 T17.004 **Keynote Presentation**  
**Standards for Creep-Fatigue Crack Initiation and Crack Growth Testing of Metallic Materials**  
 B. Dogan\*, D. Gandy, A. Saxena  
*EPRI, Charlotte, USA*
- 11:10 T17.001 **The Influence of the  $\gamma/\gamma'$  Microstructure Stability on the Very High Temperature/Low Stress Non-Isothermal Creep Behavior of a 4th Generation Single Crystal Nickel-Based Superalloy**  
 X. Milhet\*, M. Arnoux, J. Mendez, F. Vogel  
*LMPM-CNRS, Poitiers, France*
- 11:30 T17.002 **A Micromechanics Approach to Residual Life Assessment of Nickel-Based Superalloys**  
 H.C. Basoalto\*, J.W. Brooks, A. Wisbey  
*QinetiQ plc, Farnborough, UK*
- 11:50 T17.005 **Elevated Temperature Crack Growth Rate Model for Ni-base Superalloys**  
 J.L. Evans\*, A. Saxena  
*University Of Arkansas, Fayetteville, USA*

**T17-S2****Thursday July 16, 13:30 – 15:10**

Westin Hotel - Governor General III Room

Chair: B. Dogan, *EPRI, Charlotte, USA*

- 13:30 T17.006 **Creep Damage by Multiple Cavity Growth Controlled by Grain Boundary Diffusion**  
 B. Fedelich\*, J. Owen  
*Bundesanstalt für Materialforschung und -prüfung, (BAM), Berlin, Germany*
- 13:50 T17.007 **High Temperature Mechanical Strength and Microstructural Stability of Advanced 9-12%Cr Steels and ODS Steels**  
 B. Fournier\*, J. Malaplate, F. Dalle, M. Sauzay, Y. de Carlan, A. Pineau, M. Salvi, C. Caës  
*CEA Saclay, DEN/DANS/DMN/SRMA, Gif sur Yvette, France*
- 14:10 T17.010 **Influence of Hold Times on Fatigue Life and Fracture Behavior of Cast Superalloy INCONEL 713LC at 700 C**  
 K. Obrtlík\*, J. Man, J. Polák, M. Petrevec, T. Podrábský  
*Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno, Czech Republic*
- 14:30 T17.009 **Finite Elements Simulation of Creep Crack Growth**  
 M.R. Kabiri\*, L. Laiarinandrasana, R. Piques  
*Ecole Nationale Supérieure d'Arts et Métiers, Meknès, Morocco*
- 14:50 T17.020 **Mechanisms of Fatigue and Fracture in Mo-Si-B alloys at Elevated Temperatures in Air and Inert Atmospheres**  
 J.A. Lemberg\*, R.O. Ritchie  
*Lawrence Berkeley National Laboratory and University of California Berkeley, US*



**T17-S3****Thursday July 16, 15:30 – 16:50**

Westin Hotel - Governor General III Room

Chair: J.L. Evans, *University Of Arkansas, USA*

- 15:30 T17.012 **Creep Fracture Processes in Magnesium Metal Matrix Composites**  
V. Sklenicka\*, K. Kucharova, M. Svoboda, I. Saxl  
*Inst. of Physics of Materials, Academy of Sciences, Brno, Czech Republic*
- 15:50 T17.013 **Numerical Modelling of Creep Fracture Behaviour of Medium Density Polyethylene**  
I. Skozrit\*, Z. Tonkovic  
*University Of Zagreb, Zagreb, Croatia*
- 16:10 T17.014 **Creep Crack Assessment of Components at High Temperatures**  
M. Speicher\*, A. Klenk, E. Roos, K. Maile  
*Materialprüfungsanstalt Universität Stuttgart, Stuttgart, Germany*
- 16:30 T17.016 **Effect of Multi-axial Stress on the Life of Creep Crack Growth for Welded Joint of P92 Steel**  
R. Sugiura\*, A.T. Yokobori Jr., K. Suzuki, M. Tabuchi  
*Tohoku University, Sendai, Japan*

**T17-S4****Friday July 17, 10:30 – 11:50**

Westin Hotel - Governor General III Room

Chair: M. Speicher, *Universität Stuttgart, Germany*

- 10:30 T17.017 **Evaluation of Type-IV Creep Damages in Thick Welded Joint for High Cr Steels**  
M. Tabuchi\*, H. Hongo, T. Watanabe, K. Sawada, Y. Takahashi  
*National Institute For Materials Science, Tsukuba, Japan*
- 10:50 T17.018 **Super Plastic Behavior of AISI 329 Duplex Stainless Steel at High Temperatures under Tensile Loading**  
F. Taherkhani\*, J. Aghazadeh Mohandes, E. Taherkhani  
*Amirkabir University Of Technology, Tehran, Iran*
- 11:10 T17.019 **Microstructural Evolution and Life Evaluation during Creep/Rupture Process of a Single Crystal Superalloy**  
H.C. Yu\*, Y. Li  
*Beijing Institute Of Aeronautical Materials, Beijing, China*
- 11:30 T17.011 **Effect of Grain Boundary Microstructure on Long Term Creep Fracture Mechanism of Austenitic Stainless Steels**  
N. Shinya\*, J. Kyono  
*National Institute For Materials Science, Tsukuba, Japan*

**T18-S1****Tuesday July 14, 15:30 – 17:10**

Westin Hotel - Quebec Room

Chair: W. Tyson, *Natural Resources Canada, CANMET, Canada*

- 15:30 T18.001 **Keynote Presentation**  
**Why Fibrous Composites are Tough**  
A. Kelly\*, A.H. Cottrell  
*University Of Cambridge, Cambridge, UK*
- 16:10 T13.001 **Characterizing Fracture Energy of Proton Exchange Membrane (PEM) Using a Knife Slit Test**  
K.A. Patankar\*, D.A. Dillard, M.W. Ellis, S.W. Case, Y. Lai, C. Gittleman, M. Budinski, Y. Li  
*Macromolecules and Interfaces Institute, Virginia Tech, Blacksburg, USA*
- 16:30 T20.001 **Experimental Investigation of Rheological Characteristics of Ice Slurry**  
M. Boumaza\*  
*King Saud University, Riyadh, Saudi Arabia*
- 16:50 T20.002 **Fractal Damage on Glaciers of the Italian Alps**  
B.M. Frigo\*, B.M. Chiaia  
*Politecnico di Torino, Torino, Italy*

**T19-S1****Thursday July 16, 10:30 – 12:10**

Westin Hotel - Nova Scotia Room

Chair: W. Dietzel, *GKSS-Forschungszentrum Geesthacht GmbH, Germany*

- 10:30 T19.001 **Temperature Dependences of Age-Hardening Austenitic Steels Mechanical Properties in Gaseous Hydrogen**  
A.I. Balitskii\*, L.M. Ivaskevich, V.M. Mochulskiy  
*Karpenko Physiko-Mechanical Institute, Lviv, Ukraine*
- 10:50 T19.002 **A Transient Model of Hydrogen Induced Delamination**  
A.V. Balueva\*, L.N. Germanovich  
*Gainesville College, Gainesville, USA*
- 11:10 T19.004 **Cohesive Zone Model for Hydrogen Embrittlement in Intergranular Fracture and Slow Crack Growth in Al 5xxx/7xxx Alloys**  
N. Ben-Ali\*, R. Estevez, D. Tanguy, D. Delafosse  
*Université De Lyon, INSA Lyon MATEIS CNRS 5510, Villeurbanne, France*
- 11:30 T19.005 **Role of Hydrogen in Crack Growth in Pipeline Steels Exposed to near Neutral pH Soil Environments**  
W. Chen\*, R. Kania, B. Worthingham, S. Kariyawasam  
*University of Alberta, Edmonton, Canada*
- 11:50 T19.006 **Near Tip Behavior of Ductile, Steady-State Crack Growth in a Hydrogen Charged Material**  
R.H. Dodds Jr.\*, J.C. Sobotka, P. Sofronis  
*University of Illinois, Urbana Illinois, USA*

**T19-S2****Thursday July 16, 13:30 – 15:10**

Westin Hotel - Nova Scotia Room

Chair: R.H. Dodds Jr., *University of Illinois, USA*

- 13:30 T19.007 **Modeling of the Processes of Hydrogen Absorption and Hydrogen Cracking of Steels**  
R.V. Goldstein\*, Yu.V. Zhitnikov  
*Institute For Problems In Mechanics Of The Russian Academy Of Sciences, Russia*
- 13:50 T19.008 **In-Situ Monitoring of Hydrogen Embrittlement in Ferritic Steel Pipelines**  
F.M. Haggag\*  
*Advanced Technology Corporation, Oak Ridge, USA*
- 14:10 T19.009 **Cold Cracking Delay Times for Single Pass Weld Metal**  
R. Holdstock\*, N. Pussegoda, V. Semiga, D. Begg  
*BMT Fleet Technology, Ottawa, Canada*
- 14:30 T19.010 **Effect of Hydrogen Concentration on the Ultrasonic Propagation Properties in 304 Stainless Steel**  
W.B. Kan\*, Y.B. Lu, H.L. Pan  
*East China University Of Science and Technology, Shanghai, China*
- 14:50 T19.012 **Atomistic Study of Hydrogen Distributions around Lattice Defects and Defect Energies under Hydrogen Environment**  
R. Matsumoto\*, S. Taketomi, N. Miyazaki  
*Kyoto University, Kyoto, Japan*

**T19-S3****Thursday July 16, 15:30 – 17:10**

Westin Hotel - Nova Scotia Room

Chair: W. Chen, *University of Alberta, Canada*

- 15:30 T19.013 **MOVED TO T09-S4**
- 15:50 T19.014 **The Effect of Mechanical Factors on Hydrogen Diffusion and Concentration around a Crack Tip**  
T. Ohmi\*, A.T. Yokobori Jr., K. Takei  
*Graduate School Of Engineering Tohoku University, Sendai, Japan*
- 16:10 T19.015 **Effect of Hydrogen Pickup on the Fracture Behaviour of Stainless Steel**  
R.C. Prasad\*, S. Roychowdhury, V. Kain  
*Indian Institute of Technology, Powai, Mumbai, India*
- 16:30 T19.016 **A Combined Applied Mechanics/Materials Science Approach Toward Quantifying the Role of Hydrogen on Material Degradation**  
P. Sofronis\*, M. Dadfarnia, P. Novak, R. Yuan, B. Somerday, I.M. Robertson, R.O. Ritchie, T. Kanezaki, Y. Murakami  
*University Of Illinois At Urbana-Champaign, Urbana, USA*
- 16:50 T19.017 **Hydrogen Exposure Effect on Tensile Strength of High Strength Steel Sharp Notched Specimen**  
Y. Suzuki\*, H. Itoga, S. Hamada, H. Noguchi  
*Kyushu University, Fukuoka Japan*

**T19-S4****Friday July 17, 10:30 – 12:10**

Westin Hotel - Nova Scotia Room

Chair: R. Matsumoto, *Kyoto University, Japan*

- 10:30 T19.018 **Microscopic Study on the Effect of Hydrogen on Deformation Process Near Stage II Fatigue Crack Tip**  
Y. Takahashi\*, H. Noguchi, K. Higashida, M. Tanaka  
*AIST, Fukuoka, Japan*
- 10:50 T19.019 **Hydrogen Effect on Dislocation Emission from a Crack Tip in Alpha Iron**  
S. Taketomi\*, R. Matsumoto, S. Matsumoto, N. Miyazaki  
*Kyoto University, Kyoto, Japan*
- 11:10 T19.020 **Microscopic Study on the Effect of Hydrogen on Fatigue Crack Growth Process in a Chromium-Molybdenum Steel**  
K. Yamaguchi\*, M. Shigenaga, Y. Takahashi, H. Noguchi, K. Higashida, M. Tanaka  
*Kyushu University, Fukuoka, Japan*
- 11:30 T19.011 **Effects of Hydrogen on Passivity and Stress Corrosion Cracking of Stainless Steels**  
B.T. Lu\*, J.L. Luo, Q. Yang, L.J. Qiao, L.P. Tian, L. Yu, Y.C. Lu  
*University Of Alberta, Edmonton, Canada*
- 11:50 T19.021 **Environmentally Assisted Cracking of Magnesium Alloys**  
W. Dietzel\*, M. Puff, N. Winzer, A. Atrens  
*GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht, Germany*

**T21-S1****Wednesday July 15, 10:30 – 11:50**

Conference Centre - Rideau Room

Chair: S.M. Graham, *United States Naval Academy, USA*

- 10:30 T21.001 **Impact Fatigue Damage of Glass/Epoxy Plates Predicted from a Three Parameters Model**  
K. Azouaoui\*, S. Benmedakhene, A. Laksimi, Z. Azari, G. Pluvinage  
*Université Des Sciences Et De La Technologie Houari Boumediene (USTHB), Alger, Algeria*
- 10:50 T21.002 **Deformation and Failure of a Rolled Homogeneous Alloy Steel under Dynamic Mechanical Loading in Torsion and in Compression**  
M.N. Bassim\*, A.G. Odeshi, M. Bolduc  
*University of Manitoba, Winnipeg, Canada*
- 11:10 T21.003 **Numerical Simulations of Dynamic Fracture**  
V. Bratov\*, Y. Petrov  
*Russian Academy of Sciences and St.-Petersburg State University, St.-Petersburg, Russia*
- 11:30 T21.004 **The Study of Honeycomb Material Dynamic Mechanical Properties Which under Out-Plane Impact Load**  
G. Zou\*, Z. Chang, J. Liang, J. Lu  
*Center For Mechanics Testing, Harbin Engineering University, Harbin, China*

**T21-S2****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Rideau Room

Chair: M.N. Bassim, *University of Manitoba, Canada*

- 13:30 T21.006 **Normalization Method and the Plasticity Function Form**  
S.M. Graham\*  
*United States Naval Academy, Annapolis, USA*
- 13:50 T21.007 **Micro-Macro Analysis of the Notch Tip Radius and Loading Rate Dependences of the Dynamic Crack Initiation Toughness during a High Transient Dynamic Crack Growth Experiment**  
D. Grégoire\*, H. Maigre, R. Estevez, A. Combescure  
*LaMCoS, INSA-LYON, CNRS UMR5259, Villeurbanne, France*
- 14:10 T21.008 **Incubation Time Based Description of Dynamic Fracture Processes**  
A.V. Kashtanov\*  
*St.-Petersburg State University, St.-Petersburg, Russia*
- 14:30 T21.009 **Stress-Wave Induced Fracture of Unidirectional Composites: An Experimental Study using Digital Image Correlation Method**  
D. Lee\*, H.V. Tippur  
*Auburn University, Auburn, USA*
- 14:50 T21.010 **Describing the Dynamic Response of a Ceramic: The Search for Universality in Fragmentation Statistics**  
S. Levy\*, J.F. Molinari  
*ENAC-IS-LSMS, EPFL, Lausanne, Switzerland*

**T21-S3****Wednesday July 15, 15:30 – 16:50**

Conference Centre - Rideau Room

Chair: H.-P. Winkler, *Gesellschaft für Nuklear-Service mbH, Germany*

- 15:30 T21.012 **Development of an Extended Compact Crack Arrest Specimen**  
R.E. Link\*  
*United States Naval Academy, Annapolis, MD, USA*
- 15:50 T21.017 **Fragmentation Efficiency of Comminution under High Velocity Impact**  
S. Sadrai\*, J.A. Meech, D. Tromans  
*University Of British Columbia, Vancouver, Canada*
- 16:10 T21.014 **Dynamic Impact Behavior of 6061-T6 and 5083-H131 Aluminum alloys**  
A.G. Odeshi\*, M.N. Bassim, M. Bolduc  
*University of Saskatchewan, Saskatoon, Canada*
- 16:30 T21.015 **Anomalous Behavior of Strength and Yield Limits under Short Pulse Loading. Possible Explanation of Embrittlement of Nuclear Constructional Materials Irradiated at Elevated Temperatures**  
Y. Petrov\*, V. Bratov  
*Institute for Problems in Mechanical Engineering, St.-Petersburg, Russia*

**T21-S4****Thursday July 16, 10:30 – 12:10**

Conference Centre - Rideau Room

Chair: S. Levy, *ENAC-IS-LSMS, EPFL, Switzerland*

- 10:30 T21.018 **Impacts on Thin Elastic Sheets**  
N. Vandenberghe\*, R. Vermorel, E. Villermaux  
*IRPHE, CNRS - Aix Marseille Université, Marseille, France*
- 10:50 T21.005 **An Effect of Explosive Detonation Pressures on Fragmentation Characteristics of Explosive Fragmentation Munitions**  
V.M. Gold\*, E.L. Baker, I. Wu  
*US Army RDECOM-ARDEC, Picatinny Arsenal, USA*
- 11:10 T21.020 **Review of Fracture Toughness of Dynamic Loaded Ductile Cast Iron**  
H.-P. Winkler\*, R. Hüggenberg, A. Ludwig, G. Pusch, P. Trubitz  
*Gesellschaft für Nuklear-Service mbH, Essen, Germany*
- 11:30 T21.022 **Dynamic Fracture Behavior of High-Strength Concrete Studied by Means of a Drop-Weight Impact Machine**  
X.X. Zhang\*, G. Ruiz, R.C. Yu, M. Tarifa  
*Universidad De Castilla-La Mancha, Ciudad Real, Spain*
- 11:50 T21.023 **Molecular Dynamics Simulations of Fragmentation in One, Two, and Three Dimensions**  
K.L. Baker\*, D.H. Warner  
*Cornell University, Ithaca, USA*

**T22-S1****Thursday July 16, 10:30 – 12:10**Conference Centre - Wellington Room  
Chair: S. Kubo, *Osaka University, Japan*

- 10:30 T22.003 **Keynote Presentation**  
**Nondestructive Evaluation and Monitoring of Wall Thinning in Large-scale Metal Pipes by Microwaves**  
Y. Ju\*, L.S. Liu  
*Nagoya University, Nagoya, Japan*
- 11:10 T22.001 **Indentation and Imprint Mapping for the Identification of Interface Properties in Film-Substrate Systems**  
G. Bolzon\*, M. Bocciarelli  
*Politecnico di Milano, Milano, Italy*
- 11:30 T22.002 **An Effective Inverse Approach for Identifying an Impact Force Acting on CFRP Laminated Plates**  
N. Hu\*, H. Fukunaga  
*Tohoku University, Sendai, Japan*
- 11:50 T22.011 **Estimating Fatigue Damage in a CFRP Laminate with a Hole Using an Embedded FBG Sensor**  
S. Yashiro\*, T. Okabe  
*Ehime University, Matsuyama, Japan*

**T22-S2****Thursday July 16, 13:30 – 14:50**Conference Centre - Wellington Room  
Chair: M. Saka, *Tohoku University, Japan*

- 13:30 T22.005 **An Application of the Passive Electric Potential CT Method for Identification of Plural Delaminations in a Composite Material**  
S. Kubo\*, T. Sakagami, S. Yamaguchi, K. Nakatani  
*Osaka University, Osaka, Japan*
- 13:50 T22.010 **Determination of Elastic-Plastic Properties of Metallic Thin Wires by Small-Span Bending Test**  
H. Tohmyoh\*, M.A. Salam Akanda, H. Takeda, M. Saka  
*Tohoku University, Sendai, Japan*
- 14:10 T22.004 **Identification of Plastic-zone Based on Inverse Thermal Conduction Analysis and Double Frequency Lock-in Thermographic Temperature Measurement**  
H. Kawano\*, T. Sakagami, S. Kubo, N. Yamaguchi  
*Osaka University, Osaka, Japan*
- 14:30 T22.009 **Derivation of Electromigration Characteristic Constants of Metal Line Used in Electronic Devices**  
K. Sasagawa\*, T. Gomyo, A. Kirita  
*Hirosaki University, Hirosaki, Japan*

**T22-S3**

**Thursday July 16, 15:30 – 16:30**  
Conference Centre - Wellington Room  
Chair: Y. Ju, *Nagoya University, Japan*

- 15:30 T22.008 **Hybrid Moire Method for Three-dimensional Stress Analysis**  
M. Saka\*, T. Numayama, S. Ri  
*Tohoku University, Sendai, Japan*
- 15:50 T22.006 **Inverse Analysis on Bent Shape of Nanowire in Fracture Test to Estimate the Fracture Strain**  
M. Muraoka\*  
*Akita University, Akita, Japan*
- 16:10 T22.007 **Identification Method of Residual Stress Distribution in Butt-Welded Plate by Boundary Element Analysis (Experimental Examination)**  
Y. Ohtake\*, S. Kubo  
*IHI Corporation, Yokohama, Japan*



**T24-S1****Thursday July 16, 10:30 – 12:10**

Conference Centre - Centennial Room

Chair: N.R. Moody, *Sandia National Laboratories, USA*

- 10:30 T24.011 **Keynote Presentation**  
**Size and Stress State Effects on Plasticity Mediated Brittle Fracture**  
W.W. Gerberich\*, A.R. Beaber, D.D. Stauffer  
*University of Minnesota, Minneapolis, USA*
- 11:10 T24.002 **Effect of Sidewall Morphology on the Fracture and Fatigue Properties of Polysilicon Structural Films**  
D.H. Alsem\*, B.L. Boyce, E.A. Stach, R.O. Ritchie  
*Lawrence Berkeley National Laboratory, Berkeley, USA*
- 11:30 T24.012 **The Impact of Sidewall Roughness on the Macroscopic Strength of Polycrystalline Silicon**  
J. Foulk\*, B.L. Boyce, E.D. Reedy Jr.  
*Sandia National Laboratories, Livermore, USA*
- 11:50 T24.007 **Strength Evaluation of Polycrystalline Silicon Structure Considering Sidewall Morphology**  
S. Hamada\*, Y. Sugimoto  
*Kyushu University, Fukuoka, Japan*

**T24-S2****Thursday July 16, 13:30 – 15:10**

Conference Centre - Centennial Room

Chair: D.F. Bahr, *Washington State University, USA*

- 13:30 T24.008 **Keynote Presentation**  
**Fracture of Brittle Thin Films on Compliant Substrates**  
R. Huang\*, H. Mei  
*University of Texas at Austin, USA*
- 14:10 T24.010 **Compliant MEMS Device Actuation and Fracture**  
A.A. Volinsky\*, K. Du, C. Lusk  
*University of South Florida, Tampa, USA*
- 14:30 T24.009 **Interfacial Fracture in Compliant Substrate Film Systems**  
N.R. Moody\*, M.J. Cordill, M.S. Kennedy, J. Yeager, D.F. Bahr, D.P. Adams, Jr. Reedy,  
J.A. Emerson, I. Rook  
*Sandia National Laboratories, Livermore, USA*
- 14:50 T24.003 **Multi-Layer Metallic Composites as Strong Electrode Structures for MEMS**  
D.F. Bahr\*, A. Bellou, N. Overman, H.M. Zbib  
*Washington State University, Pullman, USA*

**T24-S3****Thursday July 16, 15:30 – 17:10**

Conference Centre - Centennial Room

Chair: W. Moussa, *University of Alberta, Canada*

- 15:30 T24.005 **Keynote Presentation**  
**Stress-Intensity Factor and Toughness Measurement at the Nanoscale using Confocal Raman Microscopy**  
R.F. Cook\*, Y.B. Gerbig, J. Schoenmaker, S.J. Stranick  
*National Institute Of Standards And Technology, Gaithersburg, USA*
- 16:10 T24.004 **Development of a Methodology for Measurement of Mechanical Properties of Materials Used on the Microscale**  
L. Banks-Sills\*, V. Krylov, H. Bruck, J. Fiodorov, V. Fourman, R. Eliasi  
*Tel Aviv University, Ramat Aviv, Israel*
- 16:30 T24.006 **MEMS Piezoresistive Sensor for Monitoring Bond Integrity in Adhesively Bonded Patches**  
H.H. Gharib\*, W.A. Moussa  
*University Of Alberta, Edmonton, Canada*
- 16:50 T24.013 **Deformation and Fracture of Nano-sculptured Thin Film**  
T. Sumigawa\*, T. Kitamura  
*Kyoto University, Kyoto, Japan*

**T25-S1****Thursday July 16, 13:30 – 15:10**

Conference Centre – Colonel By Room

Chair: J. Petit, *LMPM, UMR CNRS 6617 ENSMA, France*

- 13:30 T25.003 **Keynote Presentation**  
**Fatigue and Fracture Toughness Properties of Large-Bloom Mixed-Microstructure Heat-Treated Steels**  
D. Firrao\*, P. Matteis, P. Russo Spena, G.M.M. Mortarino, G. Silva, B. Rivolta, R. Gerosa, M.R. Pinasco, M.G. Ienco, M. Fabbreschi  
*DISMIC, Politecnico di Torino, Torino, Italy*
- 14:10 T25.001 **Wear of Hadfield Austenitic Manganese Steel Casting**  
J.O. Agunsoye\*, S.A. Balogun, D.E. Esezobor, M. Nganbe  
*University of Lagos, Yaba, Nigeria*
- 14:30 T25.002 **Stress Intensity Factors of a Crack Emanating from a Cold Expanded Hole : Effects of Edge Distance Ratio**  
M. Arian Nik\*, M.R. Ayatollahi  
*Iran University of Science and Technology, Tehran, Iran*
- 14:50 T25.004 **Constitutive Parameters, Mechanical Properties and Failure Mechanism in DC-Cast AA7050 Billets**  
M. Lalpoor\*, D.G. Eskin, L. Katgerman  
*Materials Innovation Institute, Delft, The Netherlands*

**T25-S2****Thursday July 16, 15:30 – 17:10**

Conference Centre – Colonel By Room

Chair: D. Firrao, *DISMIC, Politecnico di Torino, Italy*

- 15:30 T25.005 **Effect of Dynamic Strain Aging on Fracture in Aluminum Alloy Sheet Materials AA5754**  
J. Kang\*, R.K. Mishra, D.S. Wilkinson, A.J. Beaudoin, J.D. Embury  
*McMaster University, Hamilton, Canada*
- 15:50 T25.010 **MOVED TO T01-S2**
- 16:10 T25.007 **Nucleation, Growth and Coalescence of Voids in Dual Phase Steels: From Model Microstructures to Microstructure Based Modeling**  
A.P. Pierman\*, C. Tekoglu, T. Pardoen, P.J. Jacques  
*Université Catholique De Louvain, Louvain-La-Neuve, Belgium*
- 16:30 T25.008 **Near Threshold Fatigue Crack Growth Behavior of a Third Generation Aluminium-Lithium Alloy**  
S. Richard\*, C. Sarrazin-Baudoux, J. Petit  
*LMPM ENSMA, Chasseneuil du Poitou, France*
- 16:50 T25.009 **Size Effect in Finite-Life Fatigue of Metals**  
S. Vantadori\*, A. Carpinteri, A. Spagnoli  
*University of Parma, Italy*

**T26-S1****Thursday July 16, 15:30 – 17:30**

Conference Centre - Rideau Room

Chair: S-W. Yu, *Tsinghua University, China*

- 15:30 T26.002 **Fatigue Crack Internal Initiation Mechanism of 50 Steel under Ultra-high-cycle Regime**  
Q. Gao\*, H. Wang, G.Z. Kang  
*Southwest Jiaotong University, Chengdu, P.R.China*
- 15:50 T26.003 **Experiment and Simulation of Very-High-Cycle Fatigue Behavior for Low Alloy Steels**  
Y. Hong\*, G. Qian, C. Zhou  
*LNM, Institute Of Mechanics, Chinese Academy Of Sciences, Beijing, China*
- 16:10 T26.004 **Cohesive Zone Models in Materials with Various Microstructures**  
V. Kozak\*  
*Institute of Physics of Material AS, Brno, Czech Republic*
- 16:30 T26.009 **Modeling the Influence of Grain Boundaries on Fracture Toughness by a Combined Dislocation - Cohesive Zone Model**  
X.H. Zeng\*, A. Hartmaier  
*Interdisciplinary Centre For Advanced Materials Simulation, Ruhr-University Bochum, Bochum, Germany*
- 16:50 T26.010 **Microstructural Modeling of Failure Modes in Crystalline Materials**  
T.M. Hatem\*, M.A. Zikry  
*North Carolina State University, Raleigh, USA*
- 17:10 T26.005 **Establishment of Higher-Order Gradient Constitutive Equations by Homogenization: Application to Brittle or Quasi-Brittle Materials with Many Micro-Cracks**  
J. Li\*, T.T. Pham, R. Abdelmoula  
*LPMTM, CNRS UPR 9001, Université Paris XIII, Villetaneuse, France*

**T27-S1****Thursday July 16, 10:30 – 12:10**

Westin Hotel - British Columbia Room

Chair: E. Gdoutos, *Robert McCormick School of Engineering, Evanston, USA*

- 10:30 T27.001 **Crack Growth Resistance of Alumina and Zirconia under Mixed Mode I-II Deformation**  
M.R. Ayatollahi\*, M.R.M. Aliha  
*Iran University of Science and Technology, Tehran, Iran*
- 10:50 T27.002 **Analysis of Crack Trajectories in Ni-base Superalloy Plates Using Coupled Non-Local Damage-Plasticity Modeling**  
J.P. Belnoue\*, A.M. Korsunsky  
*University of Oxford, Oxford, UK*
- 11:10 T27.003 **Computational Fracture Analyses of Modified Compact Tension Shear (CTS) Specimens**  
F.-G. Buchholz\*, G.-Y. Qi, S.Y. Yan, Q.-F. Li  
*Institute of Applied Mechanics, University of Paderborn, Paderborn, Germany*
- 11:30 T27.004 **Three-Dimensional Crack Growth in Multi-Layered Architectures for Automotive Plain Bearings**  
A. Burke-Veliz\*, S. Syngellakis, P.A.S. Reed  
*University Of Southampton, UK*
- 11:50 T27.005 **3D Fatigue Crack Growth in Mixed Mode II + III**  
V. Doquet\*, G. Bertolino, E. Merhy  
*LMS, CNRS, Ecole Polytechnique, Palaiseau, France*

**T27-S2****Thursday July 16, 13:30 – 14:50**

Westin Hotel - British Columbia Room

Chair: M. R. Kabiri, *Ecole Nationale Supérieure d'Arts et Métiers , Morocco*

- 13:30 T27.011 **On Mixed Mode Stable Crack Growth through AISI 4340 Steel and 2024 T3 Aluminium Alloy in Terms of CTOD/CTOA**  
D.N. Jadhav\*, S.K. Maiti, N. Jaya Raju  
*Indian Institute Of Technology Bombay, Mumbai, India*
- 13:50 T27.008 **On the Delamination Thresholds Behaviour of Gass/Epoxy Laminates under Mixed Mode Fatigue Loading**  
M. Kenane\*, M.L. Benzeggagh, S. Benmedakhene  
*USTHB, Bab Ezzouar, Alger, Algeria*
- 14:10 T27.012 **Crack Propagation Paths near Bi-Material Interfaces**  
L. Marsavina\*, T. Sadowski, M. Knec  
*POLITEHNICA University Of Timisoara, Romania*
- 14:30 T27.010 **Crack Initiation at a v-notch under Complex Loadings- Statistical Scattering**  
D. Leguillon\*, S. Murer, N. Recho, J. Li  
*University Pierre et M. Curie, CNRS UMR 7190, Paris, France*

**T27-S3****Thursday July 16, 15:30 – 16:50**

Westin Hotel - British Columbia Room

Chair: P. Zerres, *Technische Universität Darmstadt, Germany*

- 15:30 T27.013 **A New Mixed Mode Fracture Specimen (2MCG): Numerical and Experimental Results**  
F. Dubois\*, R. Moutou Pitti, P. Octavian  
*Limoges University, Limoges, France*
- 15:50 T27.014 **Mixed Mode Fracture Testing of Adhesively Bonded Specimens using a Dual-Actuator Load Frame**  
E. Nicoli\*, H.K. Singh, D.A. Dillard, C.E. Frazier  
*Virginia Tech, Blacksburg VA, USA*
- 16:10 T27.017 **Study on Curved Paths of Wing Cracks under Compression**  
L. Qiang\*, Y. Qing  
*Shijiazhuang Railway Institute, Hebei, China*
- 16:30 T27.016 **Experimental Approach of Mixed Mode Separation Using Digital Image Correlation and Integral Invariant Mtheta**  
O. Pop\*, F. Dubois, R. Moutou Pitti, V. Valle  
*GEMH-GCD Laboratory; Limoges University, France*

**T27-S4****Friday July 17, 10:30 – 11:50**

Westin Hotel - British Columbia Room

Chair: F. Dubois, *Limoges University, France*

- 10:30 T27.018 **A Plasticity Framework for (Linear Elastic) Fracture Mechanics**  
A. Salvadori\*  
*University Of Brescia, Brescia, Italy*
- 10:50 T27.019 **Irwin's Crack Closure Integral and the Calculation of Mode-I, II Stress Intensity Factors in Anisotropic Elastic Media**  
M. Specovius-Neugebauer\*, M. Fulland, S.A. Nazarov, H.A. Richard, M. Steigemann  
*Institute of Applied Mathematics, University Of Kassel, Germany*
- 11:10 T27.020 **Mixed-Mode Crack Growth in Cold-Drawn Pearlitic Steel Wires**  
J. Toribio\*  
*University Of Salamanca, Zamora, Spain*
- 11:30 T27.021 **Modeling of Crack Propagation under Mixed-Mode Loading with Advanced Remeshing**  
P. Zerres\*, M. Vormwald  
*Technische Universität Darmstadt, Germany*

**T28-S1****Monday July 13, 10:30 -12:10**

Conference Centre - Colonel By Room

Chair: N. Noda, *Shizuoka University, Japan*

- 10:30 T28.001 **Analysis of the Dynamic Behavior of a Moving Crack in FGMs Using Non-local Theory**  
X. Bi\*, X. Cai, X. Qian  
*Fujian University Of Technology, Fuzhou, P. R. China*
- 10:50 T28.002 **Damage Development in Two Thermal Barrier Coating Systems**  
H. Brodin\*, S. Sjoström, S. Johansson  
*Siemens Industrial Turbomachinery, Finspång, Sweden*
- 11:10 T28.003 **Initiation Mechanism of Bulges Deformation in a Coke Drum**  
M. Daimaruya\*, M. Oka, H. Fujiki, H. Ambarita, T. Yamada, K. Tomizawa  
*Muroran Institute of Technology, Muroran, Japan*
- 11:30 T28.005 **Automatic Simulation of Fatigue Crack Growth in Three-Dimensional Structures Consisting of Functionally Graded Materials**  
M. Fulland\*, M. Steigemann, H.A. Richard, M. Specovius-Neugebauer  
*Westfälisches Umwelt Zentrum, Paderborn, Germany*
- 11:50 T28.011 **A Novel Potential-Based Approach for Mixed-Mode Cohesive Fracture Simulation**  
K. Park\*, G.H. Paulino, J. Roesler  
*University of Illinois at Urbana-Champaign, Urbana, USA*

**T28-S2****Monday July 13, 15:30 – 17:10**

Conference Centre - Colonel By Room

Chair: Y. Ootao, *Osaka Prefecture University, Japan*

- 15:30 T28.006 **Interfacial Cracking in Graded and Layered Metal-Ceramic Composites by Fracture Mechanical Analysis**  
A. Kumar\*, U. Roy, M. Bhattacharyya, S. Kapuria  
*Carleton University, Ottawa, Canada*
- 15:50 T28.007 **Plane Elastic Behavior and Stress Intensity Factor for an Inhomogeneous Infinite Medium with a Griffith Crack**  
R. Kawamura\*, S. Ishida, Y. Ootao, Y. Tanigawa, K. Ikeda  
*University of Miyazaki, Miyazaki, Japan*
- 16:10 T28.008 **Crack Interaction Problems in Functionally Graded/ Homogeneous Bimaterials Subjected to a Heat Flux**  
V. Petrova\*, S. Schmauder  
*Voronezh State University, Voronezh, Russia*
- 16:30 T28.009 **Fatigue Crack Growth in Two-Dimensional Structures Consisting of Functionally Graded Materials**  
M. Steigemann\*, M. Fulland, M. Specovius-Neugebauer, H.A. Richard  
*University of Kassel, Germany*
- 16:50 T28.010 **Analysis of a Functionally Graded Strip with a Crack**  
Z. Zhong\*, J. Ma, Z. Cheng  
*Tongji University, Shanghai, China*

**T29-S1****Wednesday July 15, 10:30 – 12:10**

Conference Centre – Wellington Room

Chair: N.M. Pugno, *Università Degli Studi Di Palermo, Italy*

- 10:30 T29.003 **Keynote Presentation**  
**Atomistic Fracture and Nano-Macro Transition for Strength and Lifetime Statistics of Quasibrittle Structures**  
 Z.P. Bazant\*, J.-L. Le, M.Z. Bazant  
*Northwestern University, Evanston, USA*
- 11:10 T29.001 **A Comprehensive End-Surface Pattern Analysis of both Broken and Cleaved Conventional and Microstructured Optical Fibers**  
 S.S. Aboutorabi\*, V. François  
*École Polytechnique de Montréal, Canada*
- 11:30 T29.002 **Fracture in Next Generation Nanocomposite Li-Anodes**  
 K.E. Aifantis\*, S.A. Hackney, T. Sarakonsri, J.P. Dempsey  
*Aristotle University Of Thessaloniki, Thessaloniki, Greece*
- 11:50 T29.005 **Soft-Soft Nanocomposites for Adhesive Applications**  
 F. Deplace\*, C. Creton, M. Rabjohns, J. Marchal, C. Carelli, A. Foster, C. Lei, A. Chateauinois, J. Keddie, P.A. Lovell  
*ESPCI-CNRS-UPMC, Paris, France*

**T29-S2****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Wellington Room

Chair: K.E. Aifantis, *Aristotle University Of Thessaloniki, Greece*

- 13:30 T29.007 **Interface Fracture of Bicrystals in Multiscale**  
 Q. Zhao\*, S.V. Hoa, Z.J. Gao  
*Concordia University, Montréal, Canada*
- 13:50 T29.008 **Fracture and Wear of 'Nanotowers'**  
 A.N. Kaufmann\*, H. Schiff, E. Meyer, T.A. Jung  
*Paul Scherrer Institute, Villigen, Switzerland*
- 14:10 T29.009 **Application of Improved Indentation Fracture Mechanics Approaches on In-Situ Polymerized Organic-Inorganic Nanocomposites**  
 R. Lach\*, T. Koch, B. Feichtenschlager, G. Kickelbick, S. Seidler  
*Vienna University of Technology, Institute of Materials Science and Technology, Vienna, Austria*
- 14:30 T29.010 **Strength and Fracture of Nano-Objects**  
 N.F. Morozov\*, A.V. Ankudinov, V.A. Bratov, V.A. Eremeyev, E.A. Ivanova, Yu.V. Petrov  
*Russian Academy of Sciences, St.-Petersburg, Russia*
- 14:50 T29.011 **An Optimised Tapered Shape of the Terminal Contact Elements in Biological Attachment Devices**  
 N.M. Pugno\*, A. Pantano, S. Gorb  
*Università Degli Studi Di Palermo, Palermo, Italy*



**T29-S3****Wednesday July 15, 15:30 – 16:50**

Conference Centre – Wellington Room

Chair: A.N. Kaufmann, *Paul Scherrer Institute, Switzerland*

- 15:30 T29.012 **Functional Mechanism of Biological Adhesive Systems Described by Multiple Peeling Approach: A New Angle for Optimal Adhesion**  
N.M. Pugno\*, S.N. Gorb  
*Politecnico Di Torino, Torino, Italy*
- 15:50 T29.013 **Ab initio DFT and Classical MD Simulations of Fracture of Si Thin Films**  
Y. Umeno\*  
*Institute Of Industrial Science, University Of Tokyo, Tokyo, Japan*
- 16:10 T29.014 **Effect of Vacancy Diffusion on Crack Initiation in the Lennard-Jones Crystal**  
O.G. Vinogradov\*  
*University of Calgary, Alberta, Canada*
- 16:30 T29.015 **Deformation of Ceramics at Small Scales and Elevated Temperatures**  
S. Korte\*, W.J. Clegg  
*University Of Cambridge, Cambridge, UK*

**T30-S1**

Thursday July 16, 13:30 – 15:10

Westin Hotel - Governor General II Room

Chair: A. Fahr, *National Research Council Canada, Ottawa, Canada*

- 13:30 T30.001 **Continuous Evaluation of Microfracture Mode in Metals by AE Wavelet Transform Analysis**  
M. Enoki\*, K. Ito, Y. Hirose, S.A. Khan, N. Tsurui  
*University of Tokyo, Tokyo, Japan*
- 13:50 T30.002 **Noncontact Health Monitoring of Atmospheric Plasma Spraying Process by Noise Resistant AE System**  
K. Ito\*, S. Ohmata, M. Watanabe, S. Kuroda, M. Enoki  
*University Of Tokyo, Tokyo, Japan*
- 14:10 T30.003 **Stress Intensity Factor Measurements for Fatigue Cracks in Steel Bridges Based on Thermoelastic Stress Analysis**  
Y. Izumi\*, T. Sakagami, S. Kubo  
*Osaka University, Osaka, Japan*
- 14:30 T30.004 **Bolt Hole Eddy Current Testing Probability of Detection Part - I: Experimental Design and Data Analysis**  
M. Khan\*, M. Yanishevsky, A. Fahr  
*National Research Council Canada, Ottawa, Canada*
- 14:50 T30.006 **Bolt Hole Eddy Current Testing Probability of Detection Part -II: Numerical Modeling as a Cost-Reduction Tool**  
C. Mandache\*, M. Khan, A. Fahr  
*National Research Council Canada, Institute for Aerospace Research, Ottawa, Canada*

**T30-S2**

Thursday July 16, 15:30 – 17:30

Westin Hotel - Governor General II Room

Chair: Y. Izumi, *Osaka University, Japan*

- 15:30 T30.005 **Identification of Damage in Reinforced Concrete Structures from Different Levels of Earthquake Excitations**  
C.-H. Loh\*, J.-H. Weng, S.-H. Chao, W.-I. Liao  
*National Taiwan University, Taipei, Taiwan*
- 15:50 T30.007 **The Evolution of Defect Sizing: Where We Stand Today**  
M. Moles\*  
*Olympus NDT, Toronto, Canada*
- 16:10 T30.009 **Mechanisms of Concrete Fracture Analyzed by AE-SiGMA with Automatic Detector of First Motion**  
K. Ohno\*, M. Ohtsu  
*Kumamoto University, Kumamoto, Japan*
- 16:30 T30.010 **Damage Monitoring of Composite Materials by Using Acoustic Emission**  
A. Refahi Oskouei\*, M. Hajikhani, M. Ahmadi  
*Amirkabir University of Technology, Tehran, Iran*
- 16:50 T30.011 **Enhanced Ultrasonic Defect Sizing Techniques using Weiner Filtering and Autoregressive Spectral Extrapolation**  
L.J.G. Wesley\*, A.N. Sinclair, M. Moles  
*University of Toronto, Canada*
- 17:10 T30.008 **Crack Detection in Short Beams Using Frequency Data**  
P. Razi\*, S. Moradi, L. Fatahi  
*Shahid Chamran University, Ahwaz, Iran*

**T31-S1****Thursday July 16, 10:30 – 12:10**

Conference Centre - Gatineau Room

Chair: K.R.W. Wallin, *Academy of Finland, VTT, Finland*

- 10:30 T31.009 **Keynote Presentation**  
**SIAM-CM09 - A Procedure for Applying the Cohesive Model to the Damage Behavior of Engineering Materials and Structures**  
I. Scheider\*, K.-H. Schwalbe  
*GKSS Research Centre, Geesthacht, Germany*
- 11:10 T31.008 **Estimation Procedure of J-R Curves for SE(T)Fracture Specimens Based on CMOD Data**  
C. Ruggieri\*, S. Cravero  
*University of Sao Paulo, São Paulo, Brazil*
- 11:30 T31.002 **Fully-Plastic J Solutions for Pipes with Circumferential Surface Cracks Subjected to Bending Moment**  
M.S.G. Chiodo\*, C. Ruggieri, G.H.B. Donato  
*University Of São Paulo, São Paulo, Brazil;*
- 11:50 T31.015 **Finite Element Modeling of Compact Tension and Burst Specimens using the Crack Tip Opening Angle as a Crack Propagation Criterion for Zr-2.5Nb Pressure Tube Material**  
B.W. Williams\*, K. Tsembeles, S. St Lawrence, B.W. Leitch  
*Atomic Energy of Canada Limited, Chalk River, Canada*

**T31-S2****Thursday July 16, 13:30 – 14:50**

Conference Centre - Gatineau Room

Chair: R. E. Link, *United States Naval Academy, USA*

- 13:30 T31.007 **The Load Separation Method in Nonlinear Fracture Mechanics**  
Yu.G. Matvienko\*  
*Mechanical Engineering Research Institute of The Russian Academy Of Sciences, Moscow, Russia*
- 13:50 T31.011 **CTOA Measurements Using Digital Image Correlation**  
Y.H. Tai\*, D.T. Asquith, J.R. Yates  
*University Of Sheffield, UK*
- 14:10 T31.006 **Measuring Upper Shelf Fracture Toughness on Precracked Charpy Specimens without Using a Clip-on-Gage**  
E. Lucon\*, M. Scibetta  
*SCK-CEN, Mol, Belgium*
- 14:30 T31.003 **A Modified Three Point Bend Specimen**  
K. Eriksson\*  
*Luleå University of Technology, Lulea, Sweden*

**T31-S3****Thursday July 16, 15:30 – 17:10**

Conference Centre - Gatineau Room

Chair: I. Scheider, *GKSS Research Centre, Germany*

- 15:30 T31.013 **3D Analysis of Tests on CT\_POR Specimens submitted to WPS Cycles using the Energy Approach of Elastic Plastic Fracture Mechanics**  
Y. Wadier\*, Y. Mézière, M. Bonnamy  
*EDF-RandD, Clamart, France*
- 15:50 T31.001 **Energetic Method for the Construction of a Cohesive Law from a Nonlocal Elastoplastic Damage Model**  
F. Cazes\*, A. Simatos, M. Coret, A. Gravouil, A. Combescure  
*LaMCoS, Lyon, France*
- 16:10 T31.012 **Characterisation and Prediction of Brittle Fracture in a Ferritic Steel under General Loading Conditions**  
C.E. Truman\*, S.J. Lewis, D.J. Smith  
*University Of Bristol, UK*
- 16:30 T31.010 **Energetic Construction of a Cohesive Law from the Rousselier Model**  
A. Simatos\*, F. Cazes, A. Combescure, M. Coret, S. Marie  
*LaMCoS, INSA- Lyon, CNRS UMR5259, Villeurbanne, France*
- 16:50 T31.014 **Improved hp Factors for C(T) and SE(B) Specimens**  
K.R.W. Wallin\*  
*Academy of Finland, VTT, Espoo, Finland*

**T32-S1****Monday July 13, 10:30 – 12:10**

Westin Hotel - British Columbia Room

Chair: S. Ritter, *Paul Scherrer Institute, Switzerland*

- 10:30 T32.001 **Keynote Presentation**  
**Emerging Environmental Cracking Issues in High Temperature Water**  
P.L. Andresen\*, M.M. Morra  
*GE Global Research Center, Schenectady, USA*
- 11:10 T32.002 **Analyses of Dynamic Fracture Toughness Data of Ductile Cast Iron Based on ASME Code Case N-670 and ASTM E 1921**  
W. Baer\*  
*BAM Federal Institute for Materials Research and Testing, Berlin, Germany*
- 11:30 T32.003 **Numerical Evaluation of the WPS Benefit for a Sub-Clad Defect in a Reactor Pressure Vessel**  
S. Chapuliot\*  
*AREVA NP SAS, France*
- 11:50 T32.004 **Investigation of the Characterization of Material Inhomogeneity and Its Effect on the Ductile-to-Brittle Transition in Ferritic Steel**  
J.A. Joyce\*, R.L. Tregoning  
*U.S. Naval Academy, Annapolis, USA*

**T32-S2****Monday July 13, 15:30 – 17:30**

Westin Hotel - British Columbia Room

Chair: P.L. Andresen, *GE Global Research Center, USA*

- 15:30 T32.007 **Relationship between Burst Specimens, Compact Tension Specimens, Material Chemistry, and Operating Conditions for Zr-2.5Nb Pressure Tube Material**  
A. Veeramany\*, M.D. Pandey, B.W. Williams  
*University of Waterloo, Canada*
- 15:50 T32.006 **Analysis and Multi-Material Modeling of Fracture Mechanics Tests on Welded Joints**  
T.H. Nguyen\*, C. Niclaeys, S. Marie, S. Chapuliot, S. Degallaix-Moreuil  
*CEA-Saclay, DEN/DM2S/SEMT/LISN, Gif sur Yvette, France*
- 16:10 T32.009 **The Influence of Chloride Impurities on the SCC Crack Growth Behavior of Low-Alloy Reactor Pressure Vessel Steels under Simulated BWR Conditions**  
S. Ritter\*, H.P. Seifert  
*Paul Scherrer Institute, Villigen PSI, Switzerland*
- 16:30 T32.014 **Experimental Research of Crack Growth Resistance of**  
L. Sosnovskiy\*, A.V. Bogdanovich, S.S. Sherbakov.  
*SandP Group TRIBO-FATIGUE, Gomel, Belarus*
- 16:50 T32.008 **A Three Constants Kinematic Hardening Law for Simulating Low Cycle Fatigue and Ratcheting Behavior of SA333 Steel**  
S. Paul\*, M. Tarafder, S. Dhar, S. Tarafder  
*National Metallurgical Laboratory, Jamshedpur, India*
- 17:10 T32.015 **Stress Corrosion Cracking Behaviour of Surface Mechanical Attrition Treated Alloy 600 SG Tubing Specimens**  
S. Ramamurthy\*, M. Faichuk, W.M.L. Lau, J. Lu, R.C. Newman  
*Surface Science Western / The University Of Western Ontario, London, Canada*

**T32-S3****Tuesday July 14, 10:30 – 12:10**

Westin Hotel - British Columbia Room

Chair: J.A. Joyce, *U.S. Naval Academy, USA*

- 10:30 T32.011 **Unstable Crack Propagation under Severe Accidental Scenario Conditions in a Pressurized Water Reactor**  
N. Tardif\*, M. Coret, A. Combescure, V. Koundy  
*IRSN / DSR / SAGR, Fontenay-aux-roses, France*
- 10:50 T32.012 **Fracture Mechanics Characterization of Russian WWER Type Reactor Pressure Vessel Welding Seams**  
H.-W. Viehrig\*, J. Schuhknecht  
*Forschungszentrum Dresden-Rossendorf, Dresden, Germany*
- 11:10 T32.013 **3D Modelling of Intergranular Stress Corrosion Cracking (IGSCC)**  
Y. Zhang\*, T.J. Marrow, A.H. Sherry  
*University Of Manchester, Manchester, UK*
- 11:30 T32.005 **Impact of Zirconium Hydride on the Fracture of a Zirconium Alloy: Crack Tip Strain Mapping in Zircaloy-2**  
M. Kerr\*, M.R. Daymond, R.A. Holt, J.D. Almer  
*Queen's University, Kingston, Canada*
- 11:50 T32.010 **Effect of Low Temperature Ageing on Fracture Toughness and Fatigue Crack Growth Behaviour of SS 316(N) Weld**  
G. Sasikala\*, S. Venugopal, K.G. Samuel, S.K. Ray, B. Shashank Dutt  
*Indira Gandhi Centre For Atomic Research, Kalpakkam, India*

**T35-S1**

Sponsored by EVRAZ

**Monday July 13, 10:30 – 12:10**

Westin Hotel - Nova Scotia Room

Chair: D. Boyd, *Queen's University, Canada*

- 10:30 T35.007 **Keynote Presentation**  
**Effect on Fracture Toughness of Combined Loading Conditions in Pipelines**  
H.A. Ernst\*, S. Cravero, R.E. Bravo  
*Tenaris Group, Campana, Argentina*
- 11:10 T35.001 **Simplified Estimation Method for Inelastic Energy Release Rate**  
R. Adibi-Asl\*, R. Seshadri  
*Memorial University, St. John's, Canada*
- 11:30 T35.012 **Characterization of Mode I Stable Crack Growth through SA333 Gr6 Steels in Terms of CTOD/CTOA and its Transferability to through-the-Thickness Circumferential Crack Growth through Pipes**  
S.K. Maiti\*, N. Jaya Raju  
*Indian Institute Of Technology Bombay, Mumbai, India*
- 11:50 T35.010 **Notch Fracture Mechanics Two Parameter Criterion Kp-Teff**  
M. Hadj Méliani\*, Z. Azari, G. Pluvinage  
*Hassiba Benbouali University of Chlef, Algeria*

**T35-S2**

Sponsored by EVRAZ

**Monday July 13, 15:30 – 17:10**

Westin Hotel - Nova Scotia Room

Chair: H.A. Ernst, *Tenaris Group, Argentina*

- 15:30 T35.006 **Keynote Presentation**  
**Speed Dependent Fracture Toughness and the Effect on Fast Ductile Fracture Propagation in Gas Pipelines**  
D.-M. Duan\*, J. Zhou  
*TransCanada Pipelines Ltd, Calgary, Canada*
- 16:10 T35.015 **An Analytical Model to Estimate the Crack Arrest Capability of a Pipeline from the Charpy Fracture Energy**  
H.-J. Schindler\*  
*Mat-Tec AG, Winterthur, Switzerland*
- 16:30 T35.014 **FEM Model of Flat-to-Shear Transition in a Pipeline Steel DWTT Specimen**  
G. Roy\*, S. Xu, W.R. Tyson  
*Natural Resources Canada, CANMET / MTL, Ottawa, Canada*
- 16:50 T35.002 **A Robust Asymptotically Based Modeling Approach for Two-Phase Gas-Liquid Flow in Fractures**  
M.M. Awad\*, S.D. Butt  
*Memorial University Of Newfoundland, St. John's, Canada*

**T35-S3****Sponsored by EVRAZ****Tuesday July 14, 10:30 – 12:30**

Westin Hotel - Nova Scotia Room

Chair: L.N. Pussegoda, *BMT Fleet Technology Limited, Canada*

- 10:30 T35.005 **Keynote Presentation**  
**Crack Tip Opening Angle Applications and Developments in Pipeline Industry**  
Ph.P. Darcis\*, E.S. Drexler, R. Fields, J.D. McColskey, C.N. McCowan, R. Reuven, T.A. Siewert  
*NIST, Boulder, USA*
- 11:10 T35.018 **Experimental Validation of Simplified Single-Specimen CTOA Method for DWTT Specimens**  
S. Xu\*, W.R. Tyson, R. Bouchard  
*Natural Resources Canada, CANMET, Ottawa, Canada*
- 11:30 T35.009 **Analysis of Leak-before-Rupture for Cracks in Pipelines Tearing Instability Approach**  
M. Gao\*, R. McNealy, R. Krishnamurthy, D. Katz, S. Limon  
*Blade Energy Partners, Houston, USA*
- 11:50 T35.008 **Characterization of Stable Tearing in Various Metallic Alloys using the CTOA and Delta-5 COD Fracture Parameters**  
E. Frink\*, K. Lease  
*Kansas State University, Manhattan, USA*
- 12:10 T35.019 **3D CAFE Modelling and CTOA Measurements of X100 Pipeline Steels in DCB Specimen Geometry**  
J.R. Yates\*, S. Ayvar, Y.H. Tai  
*SIRIUS, University Of Sheffield, UK*

**T35-S4****Session Sponsored by EVRAZ****Tuesday July 14, 15:30 – 16:50**

Westin Hotel - Nova Scotia Room

Chair: B. Leis, *Battelle Memorial Institute, USA*

- 15:30 T35.003 **Keynote Presentation**  
**Microstructural Effects on Brittle Fracture of High Strength Plate Steel**  
D. Boyd\*, J. El-Khazen, D. Bajwa  
*Queen's University, Kingston, Canada*
- 16:10 T35.017 **Effect of Pre-Strain on Ductility and Toughness in High Strength Line Pipe Steels**  
Y. Shinohara\*, J. Besson, Y. Madi  
*Centre Des Materiau, Mines Paris, Paristech, CNRS UMR7633, Evry, France*
- 16:30 T35.020 **Development of Leak-Rupture Criteria for Axially Through-Wall Cracked pipelines**  
X.K. Zhu\*, B.N. Leis  
*Battelle Memorial Institute, Columbus, USA*



**T35-S5****Session Sponsored by EVRAZ****Wednesday July 15, 10:30 – 11:50**

Westin Hotel - Nova Scotia Room

Chair: G. Roy, *Natural Resources Canada, CANMET / MTL, Canada*

- 10:30 T35.013 **Failure Risk Assessment of a Pipe Made in X52 Steel and Used for Transport of a Mixture of Natural Gas and Hydrogen**  
G. Pluinage\*, J. Capelle, J. Gilgert  
*Laboratoire de Fiabilité Mécanique ENIMU, PVM, Metz, France*
- 10:50 T35.016 **Development of a Wrinkled Pipeline Fatigue Ultimate Limit State Criterion**  
V. Semiga\*, S. Tiku, A. Dinovitzer, J. Zhou, M. Sen  
*BMT Fleet Technology Limited, Kanata, Canada*
- 11:10 T35.021 **An Approach to Ductile Fracture Resistance Modeling in Pipeline Steels**  
L.N. Pussegoda\*, A. Fredj  
*BMT Fleet Technology Limited, Ottawa, Canada*
- 11:30 T35.011 **Effect of Flaw Geometry on the Fracture Behavior of Wall-thinned Pipe under Internal Pressure**  
O. Kuwazuru\*, T. Meshii, I. Herman  
*University Of Fukui, Fukui, Japan*

**T36-S1****Wednesday July 15, 10:30 – 12:10**

Westin Hotel - Governor General II Room

Chair: A. Johnston, *National Research Council Canada, Ottawa Canada*

- 10:30 T36.001 **Keynote Presentation**  
**Fatigue Testing of Z-pin Reinforced Carbon-Fibre Laminates**  
A.J. Brunner\*, G.P. Terrasi, D.D.R. Cartié  
*Empa, Swiss Federal Laboratories For Materials Testing and Research, Dübendorf, Switzerland*
- 11:10 T36.002 **Pull-Push Shear Test: Analytical Solutions with Exponential Softening**  
P. Cornetti\*, A. Carpinteri  
*Politecnico Di Torino, Turin, Italy*
- 11:30 T36.003 **Deformation and Failure Behavior of Environmentally Friendly Composites**  
S.G. Pardo\*, C. Bernal, J. Cano, M.J. Abad, L. Barral Losada  
*E.U.P., Universidade De A Coruña, Ferrol, España*
- 11:50 T36.004 **Failure of Sandwich Structures**  
E. Gdoutos\*, I.M. Daniel  
*Northwestern University, Evanston, Illinois, USA*

**T36-S2****Wednesday July 15, 13:30 – 15:10**

Westin Hotel - Governor General II Room

Chair: A.J. Brunner, *Empa, Swiss Federal Laboratories For Materials Testing and Research, Switzerland*

- 13:30 T36.006 **Finite Element Modelling of Biopolymer Systems with Random Microstructure and Imperfectly Bonded Interfaces**  
S. Guessasma\*, N. Benseddig  
*INRA, Unite BIA, Nantes, France*
- 13:50 T36.007 **Modelling Off-Axis Ply Cracking and Crack-Induced Delaminations in Fibre-Reinforced Polymer Laminates**  
I.A. Guz\*, M. Kashtalyan, C. Soutis  
*Centre For Micro- and Nanomechanics (CEMINACS), University of Aberdeen, UK*
- 14:10 T36.008 **Prediction of Stiffness Degradation and Further Fracture Due to Inter-Fibre Fracture in Composite Laminates**  
L. Lambrecht\*, W. Michaeli  
*Institute Of Plastics Processing at RWTH Aachen University, Germany*
- 14:30 T36.009 **Crack Behaviour in Polymeric Composites Filled by Rigid Particles**  
Z. Majer\*, P. Hutar, L. Nahlik, Z. Knesl, E. Nezbedova  
*Institute of Physics of Materials, Academy Of Sciences Of The Czech Republic, Brno, Czech Republic*
- 14:50 T36.010 **Indentation and Face-Wrinkling of a Damaged Sandwich Beam with a Compressive Yielding Core and Cohesive Interfaces**  
R. Massabò\*, F. Campi  
*University Of Genova, Genova, Italy*

**T36-S3****Wednesday July 15, 15:30 – 16:50**

Westin Hotel - Governor General II Room

Chair: P. Cornetti, *Politecnico Di Torino, Italy*

- 15:30 T36.012 **Fatigue Propagation Test Development for Polymer-Matrix Fibre-Reinforced Laminates**  
A.J. Brunner\*, I. Paris, G. Pinter  
*Empa, Swiss Federal Laboratories For Materials Testing And Research, Dübendorf, Switzerland*
- 15:50 T36.013 **A Multiscale Modeling Methodology for Damage Progression in Polymer-Based Composites**  
X. Poulain\*, R.K. Goldberg, R. Talreja, A.A. Benzerga  
*Texas AandM University, College Station, USA*
- 16:10 T36.015 **A Computational Model for Splitting and Delamination in Laminates**  
F.P. Van Der Meer\*, L.J. Sluys  
*Delft University of Technology, Delft, The Netherlands*
- 16:30 T36.016 **Optimization of Carbon Fibre Trans-Tibial Prostheses**  
L. Vergani\*, C. Colombo  
*Politecnico Di Milano, Milano, Italy*

**T36-S4****Thursday July 16, 10:30 – 11:30**

Westin Hotel - Governor General II Room

Chair: F.P. Van Der Meer, *Delft University of Technology, The Netherlands*

- 10:30 T36.017 **FE-Modeling of Damage Propagation in Axially Compressed Composite Airframe Panels**  
W. Wagner\*, C. Balzani  
*University Of Karlsruhe (TH), Germany*
- 10:50 T36.018 **Composite Plates with Drilled and Molded Hole under Tensile Load**  
R. Zitoune\*, F. Collombet, T. Tamine, L. Crouzeix, Y-H. Grunevald  
*Université De Toulouse, INSA, UPS, LGMT, Toulouse, France*
- 11:10 T36.005 **Sensitization Induced Deterioration in Fracture Toughness of 304LN Austenitic Stainless Steel**  
S. Ghosh\*, K.K. Ray, V. Kain, H. Roy, S. Sivaprasad, S. Tarafder, A. Ray  
*Bhabha Atomic Research Centre, Mumbai, India*

**T37-S1****Monday July 13, 10:30 – 12:10**

Westin Hotel - Governor General II Room

Chair: D. Misra, *University of Louisiana, USA*

- 10:30 T37.001 **Determination of the Fracture Resistance of Polymer Gels via Cutting with Wire**  
F. Baldi\*, F. Bignotti, T. Riccò  
*University Of Brescia, Italy*
- 10:50 T37.002 **Multiaxial Fatigue Behavior of Semi-Crystalline Polymers (HDPE)**  
Y. Nadot\*, S. Castagnet, A. Berrehili, J.C. Grandidier  
*LMPM-ENSMA, Futuroscope Chasseneuil, France*
- 11:10 T37.003 **Macro- and Micro-Mechanics of Slow Crack Growth in Engineering Thermoplastics**  
A. Chudnovsky\*  
*University of Illinois at Chicago, Chicago, USA*
- 11:30 T37.004 **Numerical and Experimental Analysis of Glassy Polymer Fracture at High Rates, 1 to 5 m/s**  
R. Estevez\*, N. Saad-Gouider, C. Olagnon, H. Sautereau  
*Université De Lyon, Insa-Lyon, MATEIS CNRS UMR 5510, Villeurbanne, France*
- 11:50 T37.005 **J-R Curves of Rubber Modified Polystyrenes: The Use of Load Separation Parameter to determine Instantaneous Crack Lengths**  
P.M. Frontini\*, F. Rueda, L.A. Fasce  
*Instituto de Investigaciones en Ciencia y Tecnología de Materiales, Mar del Plata, Argentina*

**T37-S2****Monday July 13, 15:30 – 17:30**

Westin Hotel - Governor General II Room

Chair: P.M. Frontini, *Instituto de Investigaciones en Ciencia y Tecnología de Materiales, Argentina*

- 15:30 T37.006 **Anomalous Crack Propagation in Reinforced Natural Rubber**  
P. Sotta\*, D. Long, B. Gabrielle, F. Peditto, L. Vanel  
*LPMA, CNRS/RHODIA, Saint-Fons, France*
- 15:50 T37.007 **Effect of Thermal History on Structure and Impact Fracture of Polypropylene Impact-Copolymer (ICP)**  
J. Jancar\*, J. Tochacek, S. Hermanova, J. Kalfus  
*Institute Of Materials Chemistry, Brno University Of Technology, Brno, Czech Republic*
- 16:10 T37.008 **Fracture Toughness of HDPE based on Essential Work of Fracture Concept**  
P.-Y.B. Jar\*, R. Adianto  
*University Of Alberta, Edmonton, Canada*
- 16:30 T37.010 **Tough Nanoparticle-Modified Polymers**  
A.J. Kinloch\*, B.B. Johnsen, J. Sohn Lee, R.D. Mohammed, A.C. Taylor, S. Sprenger  
*Imperial College London, UK*
- 16:50 T37.022 **Fracture by Cavitation of Model Unfilled Elastomers: Experiment and Modeling**  
A. Marcellan\*, A. Cristiano, C. Creton  
*ESPCI-CNRS-UPMC, Paris, France*
- 17:10 T37.017 **On the Determination of Fracture Toughness of PP Polymers**  
A. Salazar\*, P.M. Frontini, L.A. Fasce, J. Rodríguez  
*Instituto de Investigaciones en Ciencia y Tecnología de Materiales, Mar del Plata, Argentina*

**T37-S3**

Tuesday July 14, 10:30 – 12:10

Westin Hotel - Governor General II Room

Chair: A.J. Kinloch, *Imperial College London, UK*

- 10:30 T37.012 **Nanoparticle Effects on Deformation and Fracture of Semi-crystalline Polymeric Materials**  
D. Misra\*, Q. Yuan  
*University of Louisiana at Lafayette, USA*
- 10:50 T37.013 **Characterization of the Process Zone near the Crack Tip in Filled Elastomers**  
S. Mzabi\*, C. Creton, C. Boué, F. Martin  
*Laboratoire PPMD - ESPCI-CNRS-UPMC, Paris, France*
- 11:10 T37.014 **Sub-Tg Plastic Deformation of Amorphous Polymers**  
N. Ouali\*, K. Azouaoui, A. Ahmed Benyahia, T. Boukharouba  
*Laboratoire De Mécanique Avancée, USTHB, Bab-Ezzouar, Alger, Algérie*
- 11:30 T37.015 **Fracture Toughness of Polyethylene - Silica Nanocomposite**  
A. Pegoretti\*, A. Dorigato, A. Penati  
*University of Trento, Trento, Italy*
- 11:50 T37.016 **Influence of Viscoelastic Material Behavior on Fracture Properties of Elastomers**  
K. Reincke\*, W. Grellmann, R. Lach  
*Martin Luther University Halle-Wittenberg, Halle, Germany*

**T37-S4**

Tuesday July 14, 15:30 – 17:30

Westin Hotel - Governor General II Room

Chair: Y. Nadot, *LMPM-ENSMA, Futuroscope Chasseneuil, France*

- 15:30 T37.009 **A Comparison of 2-Zone and 3-Zone Models in Tearing based on Essential Work of Fracture**  
S. Kao-Walter\*, M. Hu, M.F. Walter, A. Leon  
*Blekinge Institute Of Technology, Karlskrona, Sweden*
- 15:50 T37.018 **Influence of Domain Spacing and Molecular Architecture on the Deformation Behaviour of Polystyrene (PS) Based Thermoplastic Elastomers**  
R. Schlegel\*, Y. Duan, S. Hölzer, R. Weidisch, N. Hadjichristidis, J.W. Mays, A. Avgeropoulos  
*Institute of Materials Science and Technology, Friedrich-Schiller-University, Jena, Germany*
- 16:10 T37.019 **Tensile Properties and Deformation Mechanism of Multigraft Copolymers**  
R. Weidisch\*, Y. Duan, R. Schlegel, M. Thunga, K. Schneider, E. Rettler, H.W. Siesler, M. Stamm, J.W. Mays, N. Hadjichristidis  
*Friedrich-Schiller-University Jena, Germany*
- 16:30 T37.020 **Multiaxial Fatigue Behaviour of an Epoxy Polymer - New Fatigue Test System and Fatigue Life Prediction**  
Z. Xia\*, G. Tao  
*University of Alberta, Edmonton, Canada*
- 16:50 T37.021 **Characterizing Temporary Bonding Adhesives Using a Wedge Test**  
L. Yan\*, D.A. Dillard, T. Suga, S.M. June, T.E. Long  
*Virginia Polytechnic Institute and State University, Blacksburg, USA*
- 17:10 T37.011 **About the Possibilities to Reduce the Necessary Material Mass in Essential Work of Fracture of Polymers**  
T. Koch\*, R. Lach, S. Seidler  
*Vienna University of Technology, Vienna, Austria*

**T38-S1****Sponsored by BMT Fleet Technology****Tuesday July 14, 15:30 – 17:30**

Westin Hotel - British Columbia Room

Chair: R. Smith, *Imperial College London, UK*

- 15:30 T38.001 **Design Review of a Freight Axle: Achievement of a Million Miles Axle**  
S. Beretta\*, M. Carboni, S. Cervello  
*Politecnico di Milano, Milano, Italy*
- 15:50 T38.002 **Changes in the Fracture Toughness of a Rail Steel Subjected to High Pressure Torsion**  
A. Hohenwarter\*, R. Pippan, R. Stock  
*Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Leoben, Austria*
- 16:10 T38.003 **Improvement of Fatigue Strength for Freight Cars in Chinese Railroad**  
Y.S. Hu\*, J. Zhang, L.Z. Wang  
*Institute of Railway and Urban Mass Transit of Tongji University, Shanghai, China*
- 16:30 T38.004 **Surface Break-Outs and Related Rail Damage Development in the Vienna Mass Transit Metro System**  
H.P. Rossmannith\*, F. Loibnegger, H.N. Linsbauer, P. Mittermayerr, E. Fischmeister, A. Oberhauser  
*Institute For Testing And Research In Materials Technology, VUT, Vienna, Austria*
- 16:50 T38.005 **Fatigue Behaviour of Railway Wheel Steels under Mechanical-Thermal Service Conditions**  
C.J. Peters\*, F. Walther, D. Eifler  
*Institute of Materials Science and Engineering/University of Kaiserslautern, Kaiserslautern, Germany*
- 17:10 T38.006 **Assessment of Uncertainties in Life Prediction of Fatigue Crack Propagation in Welded Rails**  
J.W. Ringsberg\*, B.L. Josefson  
*Chalmers University of Technology, Göteborg, Sweden*

**T39-S1****Wednesday July 15, 10:30 – 11:50**

Conference Centre - Centennial Room

Chair: H. Riesch-Oppermann, *Forschungszentrum Karlsruhe GmbH, Institut für Materialforschung II, Germany*

- 10:30 T39.001 **In-Service Reliability of Hydraulic Cylinders' Housings**  
A. Altamura\*, H. Desimone, S. Beretta  
*Tenaris Dalmine RandD Center, Dalmine, Italy*
- 10:50 T39.002 **Probabilistic Lifetime Prediction for Ceramic Components under Static and Cyclic Loading**  
M. Härtelt\*, H. Riesch-Oppermann, O. Kraft  
*Forschungszentrum Karlsruhe GmbH, Institut für Materialforschung II, Eggenstein-Leopoldshafen, Germany*
- 11:10 T39.003 **Numerical Characterization of Thin-rimmed Gear Tooth Bending Fatigue Crack Propagation**  
S. Lalonde\*, R. Guilbault  
*University Of Sherbrooke, Sherbrooke, Canada*
- 11:30 T39.004 **Probabilistic Fatigue Life Prediction Considering Short Crack Growth**  
Y. Liu\*  
*Clarkson University, Potsdam, USA*

**T39-S2****Wednesday July 15, 13:30 – 14:30**

Conference Centre - Centennial Room

Chair: S. Lalonde, *University Of Sherbrooke, Canada*

- 13:30 T39.005 **Design and Operation of Long-Life Metal Structures for Low Life-Cycle Costs**  
J. Mencik\*  
*University of Pardubice, Pardubice, Czech Republic*
- 13:50 T39.006 **Probabilistic Analysis of Strength and Lifetime Data - A Bayesian Approach**  
H. Riesch-Oppermann\*, O. Kraft  
*Forschungszentrum Karlsruhe GmbH, Institut für Materialforschung II, Eggenstein-Leopoldshafen, Germany*
- 14:10 T39.007 **Rapidly Assessing the Probability of Fracture for Stiffened Panels**  
E.J. Tuegel\*, R.C. Penmetsa, V. Shanmugam  
*U.S. Air Force Research Laboratory, Dayton, USA*

**T40-S1****Thursday July 16, 10:30 – 12:30**

Conference Centre - Main Hall

Chair: A. Carpinteri, *Politecnico Di Torino, Italy*

- 10:30 T40.001 **Keynote Presentation**  
**Quasibrittle Size Effect: Problems and Progress**  
Z.P. Bazant\*, J.-L. Le, Q. Yu  
*Northwestern University, Evanston, USA*
- 11:10 T40.005 **Keynote Presentation**  
**The Mitigation of Stress-Singularities in Linear Elasticity**  
A. Carpinteri\*, M. Paggi  
*Politecnico Di Torino, Torino, Italy*
- 11:50 T40.019 **Fractal and Scale Effect on the Morphology of Sub-critical Creep Crack Growth Path**  
A.T. Yokobori Jr.\*, R. Sugiura, T. Ohmi, V.A. Yardley, T. Matsuzaki  
*Tohoku University, Sendai, Japan*
- 12:10 T40.003 **On a Physical Sense of Parameters of Statistical Distributions**  
L.R. Botvina\*  
*Baikov Institute of Metallurgy and Materials Science, Russian Academy Of Sciences, Moscow, Russia*

**T40-S2****Thursday July 16, 13:30 – 14:50**

Conference Centre - Main Hall

Chair: T. Yokobori, *Tohoku University, Japan*

- 13:30 T40.010 **Delamination vs. Shear Failure in Retrofitted Concrete Beams and Related Size-Scale Effects**  
G. Lacidogna\*, A. Carpinteri, M. Paggi  
*Politecnico Di Torino, Italy*
- 13:50 T40.016 **Probabilistic Strength Prediction of Adhesively Bonded Joints Composed of Wooden Adherends**  
T. Vallée\*, M. Lehmann, T. Tannert, M. Brunner  
*Bern University Of Applied Sciences, Biel, Switzerland*
- 14:10 T40.017 **The Simulation of Coupled Failure Mechanism in Laminates Using Discontinuous Solid-Like Shell Elements**  
C.V. Verhoosel\*, J.J.C. Remmers, R. de Borst, M.A. Gutierrez  
*Delft University of Technology, Delft, The Netherlands*
- 14:30 T40.011 **Size Effect in the Critical Remote Stress Causing Debonding at the Circular Inclusion-Matrix Interface**  
V. Mantic\*  
*School of Engineering, University of Seville, Spain*



**T40-S3****Thursday July 16, 15:30 – 16:50**

Conference Centre - Main Hall

Chair: L.R. Botvina, *Russian Academy Of Sciences,, Russia*

- 15:30 T40.015 **Size Effect Failure Criterion for Rounded Dovetail Connection**  
T. Tannert\*, T. Vallée, F. Lam  
*Bern University of Applied Sciences, Biel, Switzerland*
- 15:50 T40.007 **Size Effect Associated with Crack Interaction**  
A.V. Dyskin\*  
*University of Western Australia, Perth, Australia*
- 16:10 T40.002 **Size Effect in Dry Snow Slab Tensile Fracture**  
C.P. Borstad\*, D.M. McClung  
*University Of British Columbia, Vancouver, Canada*
- 16:30 T40.008 **Numerical Simulation of Cracking and AE Scaling in Quasi-Brittle Materials**  
S. Invernizzi\*, A. Carpinteri, G. Lacidogna  
*Politecnico di Torino, Torino, Italy*

**T40-S4****Friday July 17, 10:30 – 12:10**

Conference Centre - Main Hall

Chair: C.P. Borstad, *University Of British Columbia, Canada*

- 10:30 T40.013 **Generalized Representations of Fatigue and Size-Scale Effects on the Paris and Wöhler Regimes**  
M. Paggi\*, A. Carpinteri  
*Politecnico Di Torino, Torino, Italy*
- 10:50 T40.014 **Intermediate Asymptotics for Scaling of Stresses at the Tip of Crack in Cosserat Continuum**  
E. Pasternak\*, A.V. Dyskin  
*University Of Western Australia, Perth, Australia*
- 11:10 T40.012 **Simulation of Size Effects in Failure of Porous Elastic Solids Using Strain Gradient Elasticity in Conjunction with a Statistical Approach**  
U. Muehlich\*, L. Zybell, M. Kuna, S. Soltysiak  
*TU-Bergakademie Freiberg, Freiberg, Germany*
- 11:30 T40.004 **Fatigue Testing of a Cast Aluminum Alloy: Experimental Challenges**  
M. Brochu\*, Y. Verreman, F. Ajersch, N. Charest  
*École Polytechnique de Montréal, Montréal, Canada*
- 11:50 T40.020 **Prominent Features of Deformation and Destruction of Polycrystalline Aluminum**  
N.V. Zarikovskaya\*  
*Tomsk State University of Control System and Radioelectronics, Tomsk, Russia*

**T41-S1**

**Sponsored by BMT Fleet Technology**

**Wednesday July 15, 10:30 – 11:50**

Westin Hotel - British Columbia Room

Chair: J.W. Ringsberg, *Chalmers University of Technology, Sweden*

- 10:30 T41.002 **Keynote Presentation**  
**Fracture Mechanics Applications on Sea-going Vessels**  
J.E. Kokarakis\*, R.K. Taylor  
*Bureau Veritas, Piraeus, Greece*
- 11:10 T41.003 **The Need for Crack Arrestors in Ship Structure**  
R.A. Sielski\*  
*Naval Architect - Structures, Indio, USA*
- 11:30 T41.001 **Experimental Verification of Finite Element Failure Criteria with Respect to Strain State and Element Size**  
P. Hogström\*, J.W. Ringsberg, E. Johnson  
*Chalmers University of Technology, Göteborg, Sweden*

**T42-S1****Wednesday July 15, 10:30 12:10**

Conference Centre - Gatineau Room

Chair: X.D. Wang, *University Of Alberta, Canada*

- 10:30 T42.011 **Keynote Presentation**  
**Delayed Fracture of Cracked Piezoelectric Ceramics under Electromechanical Loading in Three-Point Bending**  
Y. Shindo\*, F. Narita, M. Hirama  
*Tohoku University, Sendai, Japan*
- 11:10 T42.001 **Process Influence on Fracture Toughness of New Generation Carbon-Epoxy Laminates**  
F. Collombet\*, M. Mulle  
*Université de Toulouse, INSA, UPS, LGMT, Toulouse, France*
- 11:30 T42.002 **A Finite Deformation Constitutive Model for the Prediction of Cyclic Behaviour of Shape Memory Alloys**  
A. Eshraghi\*, H. Jahed, S. Lambert  
*University of Waterloo, Waterloo, Canada*
- 11:50 T42.003 **Fracture of Ferroelectric Materials and Interfacial Fatigue Crack Propagation Driven by Piezoelectric Actuators**  
K.J. Hsia\*, M. Liu  
*University Of Illinois At Urbana-Champaign, Urbana, USA*

**T42-S2****Wednesday July 15, 13:30 – 15:10**

Conference Centre - Gatineau Room

Chair: Y. Shindo, *Tohoku University, Japan*

- 13:30 T42.010 **Theoretical Modeling of Heat Generation in Piezoelectric Actuators under Dynamic Driving Conditions**  
M.S. Senousy\*, R.K.N.D. Rajapakse, M.S. Gadala, D. Mumford  
*University Of British Columbia, Vancouver, Canada*
- 13:50 T42.006 **Formulation of Damage Development for Piezoelectric Ceramics under Static Compressive Stress**  
M. Mizuno\*, T. Nishikata, M. Okayasu  
*Akita Prefectural University, Yuri-Honjo, Japan*
- 14:10 T42.007 **Mechanical Charactersation of Galfenol-Based Magnetostrictive Alloys**  
A.E. Nolting\*, L.M. Cheng  
*Defense RandD Canada - Atlantic, Dartmouth, Canada*
- 14:30 T42.008 **Interaction Integrals for Cracks in Functionally Graded Magnetoelastoelectroelastic Materials**  
B.N. Rao\*, M. Kuna  
*Indian Institute Of Technology, Madras, India*
- 14:50 T42.009 **Deformation and Fracture Behavior of Carbon Nanocoil/Poly-Dicyclopentadiene Composites at Cryogenic Temperatures**  
K. Sanada\*, K. Nonomura, H. Sanga, Y. Shindo  
*Toyama Prefectural University, Toyama, Japan*

**T42-S3****Wednesday July 15, 15:30 – 16:50**

Conference Centre - Gatineau Room

Chair: B.N. Rao, *Indian Institute Of Technology, India*

- 15:30 T42.012 **Modeling of Deformation Defects Accumulation and Fracture of Austenitic TiNi Shape Memory Alloy**  
A.E. Volkov\*, M.E. Evard  
*Saint-Petersburg State University, Saint-Petersburg, Russia*
- 15:50 T42.013 **Crack Identification Using Bonded Piezoelectric Sensors/Actuators**  
X.D. Wang\*  
*University Of Alberta, Edmonton, Canada*
- 16:10 T42.014 **Thermal Effects of Ferroelectric/Magnetic Materials under Cyclic-Electric Loading**  
S. Yu\*, L. Zhang  
*Tsinghua University, Beijing, China*
- 16:30 T42.015 **Near Tip Stress Intensity Factor of an Edge Surface Crack in PZT Thin Films with 90 Domain Switching**  
X.J. Zheng\*, B. Wu, D.H. Li  
*Xiangtan University, Xiangtan, China*

**T43-S1****Wednesday July 15, 13:30 – 15:10**

Westin Hotel - British Columbia Room

Chair: X. Huang, *Carleton University, Canada*

- 13:30 T43.007 **Keynote Presentation**  
**Creep and Oxidation Behavior of Heat-Resistant Alloys with Diffusion Barrier Coating System**  
T. Narita\*, T. Izumi, T. Yoshioka, S. Ford, S. Hayashi, T. Nishimoto  
*Hokkaido University, Sapporo, Japan*
- 14:10 T43.001 **Effect of Unconventional Shot Peening on Microstructure and Residual Stresses of Ferrous Alloys**  
S. Bagheri Fard\*, I. Fernández Pariente, M. Guagliano  
*Politecnico di Milano, Milan, Italy*
- 14:30 T43.002 **Coating Pre-Cracking Effect on the LCF Fatigue Life of Superalloys for Gas Turbine Blades**  
M. Filippini\*, S. Foletti, G. Pasquero  
*Politecnico di Milano, Milano, Italy*
- 14:50 T43.003 **Influence of Post-Spraying Heat Treatments on the Oxidation and Cracking Behaviour of Thermal-Sprayed Thermal Barrier Coatings**  
X. Huang\*, W.R. Chen, X. Wu, B.R. Marple, R.S. Lima, R. Archer, P.C. Patnaik  
*National Research Council Canada, Institute for Aerospace Research, Ottawa, Canada*

**T43-S2****Wednesday July 15, 15:30 – 16:30**

Westin Hotel - British Columbia Room

Chair: L. Zhao, *National Research Council, Canada*

- 15:30 T43.005 **Lifetime Prediction of Thermal Barrier Coatings Using Computational, Experimental and Non-Destructive Tools**  
A.M.G. Luz\*, D.S. Balint, K.M. Nikbin  
*Imperial College London, UK*
- 15:50 T43.008 **Universal Criterion for Determining Stress Field and Fracture Toughness of Arbitrary Brittle Coating/Compliant Substrate Systems under Contact Loading**  
N. Demidova\*, X.J. Wu, R. Liu  
*Carleton University, Ottawa, Canada*
- 16:10 T44.005 **Adhesion Strength Measurement of Thin Polymer Coating Using Nano-Indentation Method**  
K. Kozuki\*, T. Adachi, K. Kishimoto  
*Tokyo Institute Of Technology, Tokyo, Japan*

**T44-S1****Wednesday July 15, 13:30 – 15:10**

Westin Hotel - Nova Scotia Room

Chair: F. Strepenne, *Université Catholique De Louvain, Belgium*

- 13:30 T44.006 **Keynote Presentation**  
**Enhancing the Mechanical and Fracture Properties of Nanocomposites Using Carbon Nanotubes**  
J.P. Lynch\*, K. Loh, M. Thouless  
*University of California, Davis, USA*
- 14:10 T44.001 **High Rate Adhesive Behavior of Polyurea on Aluminum**  
K. Ravi-Chandar\*, H. Zhang, A.B. Albrecht, K.M. Liechti  
*University Of Texas, Austin, USA*
- 14:30 T44.002 **Fracture of Thin Freestanding Ductile Metallic Films Characterized Using a Nanomechanical Lab-on-Chip Technique**  
M. Coulombier\*, A. Boe, A. Safi, S. Gravier, J.P. Raskin, T. Pardoen  
*Université catholique de Louvain, Louvain-la-Neuve, Belgium*
- 14:50 T44.003 **Dynamic Delamination Testing of Patterned Thin Films: A Combined Experimental and Numerical Study**  
P. Tran\*, N.R. Sottos, P.H. Geubelle, S. Kandula  
*University Of Illinois, Urbana, USA*

**T44-S2****Wednesday July 15, 15:30 – 16:30**

Westin Hotel - Nova Scotia Room

Chair: J.P. Lynch, *University of California, USA*

- 15:30 T44.009 **Wedge Opening Test for Measuring the Adhesion of Thin Films : Applications and Separation by Multiscale Modeling of the Different Energy Contributions**  
F. Strepenne\*, C. Poirier, J.P. Raskin, T. Pardoen  
*Université Catholique De Louvain, Louvain-La-Neuve, Belgium*
- 15:50 T44.010 **The Characterization of Interface Adhesion of Dissimilar Elastic-Plastic Materials by a Pressurized Blister Test Modeling**  
Y.C. Zhou\*, L.M. Jiang, H.X. Hao, Y.G. Liao  
*Ministry Of Education, Xiangtan University, Xiangtan, Hunan, China*
- 16:10 T44.008 **Measurement of Bonding Strength of Plasma-Sprayed Thermal Barrier Coatings by a Modified Four-Point-Bending Method**  
F.L. Shang\*, C.A. Sun  
*Xi'an Jiaotong University, Xi'an, China*

**T46-S1****Monday July 13, 10:30 – 12:10**

Conference Centre - Sussex Lounge

Chair: G. Glinka, *University of Waterloo, Canada*

- 10:30 T46.001 **Reactive Brazing Joint Adhesion Energy as Measured by Shaft Loaded Blister Test**  
M. Braccini\*, O. Kozlova, N. Eustathopoulos, G. Parry, M.-F. Devismes  
*SIMaP /Grenoble-INP/CNRS/UJF, St-Martin-d'Hères, France*
- 10:50 T46.002 **Fracture Toughness of Welding Alloy in Ductile Cast Iron**  
J.D. Bressan\* E.L. Gaertner, K. Lopez  
*University of Santa Catarina State, UDESC Joinville, Joinville/SC, Brazil*
- 11:10 T46.003 **Experimental Investigation on the Tensile and Fatigue Performance of Welded Joint with Aged and New Steel Plate(SWS41-SM400B, SM490B)**  
K.H. Chang\*, H.C. Park, G.C. Jang, S.F. Stiemer  
*Chung-Ang University, Seoul, Korea*
- 11:30 T46.004 **Fatigue Properties of Laser Brazed Joints of DP and TRIP Steel with a Copper-aluminium Consumable**  
M.H.E. Janssen\*, M. Janssen, M.J.M. Hermans, I.M. Richardson  
*Delft University of Technology, Delft, Netherlands*
- 11:50 T46.005 **Development of an Elastic Design Criterion for Adhesively Bonded Joints Using Generalized Stress Intensity Factors**  
A. Mintzas\*, D. Nowell  
*University Of Oxford, Oxford, UK*

**T46-S2****Monday July 13, 15:30 – 17:10**

Conference Centre - Sussex Lounge

Chair: M.H.E. Janssen, *Delft University of Technology, Netherlands*

- 15:30 T46.006 **3D Modelling of Ductile Plug Failure in Resistance Spot Welded Shear-lab Specimens (DP600 steel)**  
K.L. Nielsen\*  
*Technical University Of Denmark, Kgs. Lyngby, Denmark*
- 15:50 T46.007 **Predicting Fatigue Crack Growth Rate in Welded Aluminium Alloys: Effective Stress Ratio and Crack Closure Corrections**  
G. Servetti\*, X. Zhang, Y.-E. E-Ma, P.E. Irving  
*School of Engineering, Cranfield University, UK*
- 16:10 T46.008 **Fracture Strength Behavior for Ceramics/Metal Jointing Structure due to Varying Amount of Metal Brazing Alloy**  
N. Settsu\*, M. Takahashi, N. Okabe, K. Ogi, X. Zhu  
*Ehime University, Ehime, Japan*
- 16:30 T46.009 **Integrated Modeling of Friction Stir Welding : From Welding Conditions to Fracture Strain**  
A. Simar\*, Y. Bréchet, B. de Meester, A. Denquin, T. Pardoën  
*Université catholique de Louvain, Louvain-la-Neuve, Belgium*
- 16:50 T46.010 **Deformation and Fracture of Laser-Welded Joints of Dissimilar Materials**  
X. Zheng\*, S. Li, T. Huang  
*Beijing Institute Of Technology, Beijing, P.R.China*

**T47-S1****Tuesday July 14, 15:30 – 17:10**

Conference Centre - Sussex Lounge

Chair: H. Wang, *University of New Brunswick, Canada*

- 15:30 T47.004 **Keynote Presentation**  
**Fracture Modeling of Crack Propagation in Wood and Wood Composites Including Crack Tip Processes and Fiber Bridging Mechanics**  
J.A. Nairn\*, N. Matsumoto  
*Oregon State University, Corvallis, OR, USA*
- 16:10 T47.005 **Network Model of Mechanical Properties of Paper**  
H. Wang\*, Y. Yang, K. Li, Z.T. Chen  
*University of New Brunswick, Fredericton, Canada*
- 16:30 T47.002 **3D FEM Modeling of Slender Laterally Loaded Timber Connections**  
T. Descamps\*, S. Datoussaïd, D. Lalisse  
*FPMs, Mons, Belgium*
- 16:50 T47.003 **Evaluation of Bonding Quality between Densified and Virgin Wood Laminates in Terms of Mode I Fracture Energy**  
L. Li\*, M. Gong, K. Li, D. Li  
*University of New Brunswick, Fredericton, Canada*



**T48-S1 - Strength and Size Effects****Monday July 13, 10:30 – 11:50**

Westin Hotel - Les Saisons Room

Chair: D. Bonamy, CEA, IRAMIS, SPCSI, Gif sur Yvette, France

- 10:30 T48.014 **Keynote Presentation**  
**Crack Propagation and Depinning Transition: Effects of Microscopic Disorder**  
D. Vandembroucq\*, D. Dalmas, S. Roux  
*PMMH, ESPCI, Paris, France*
- 11:10 T48.016 **Size-Scaling of Strength and the Strength Statistics**  
M. Alava\*, P. Nukala, S. Zapperi  
*Helsinki University Of Technology, Hut, Finland*
- 11:30 T48.023 **Data Anomaly Analysis Using Nonparametric Statistical Model for Fault Detection and Lifting**  
A. Kumar\*, A. Nayak, A. Srivastava, P.C. Patnaik  
*Tecsis Corporation, Ottawa, Canada*

**T48-S2 - Pinning/Depinning****Monday July 13, 15:30 – 17:10**

Westin Hotel - Les Saisons Room

Chair: O. Ramos, Université de Lyon, France

- 15:30 T48.002 **Crack Growth in Brittle Heterogeneous Materials**  
D. Bonamy\*, S. Santucci, L. Ponson, K.-J. Maloy  
*CEA, IRAMIS, SPCSI, Gif sur Yvette, France*
- 15:50 T48.005 **Statistical Properties of Microcracking in Heterogeneous Materials: Conditions on Power-Law Scaling Correlated to Fracture Precursors**  
S. Deschanel\*, L. Vanel, G. Vigier, N. Godin, S. Ciliberto  
*Université de Lyon, INSA-Lyon, CNRS, France*
- 16:10 T48.004 **Direct Observation and Analysis of Crack Pinning at an Heterogeneous Interface**  
D. Dalmas\*, D. Vandembroucq, E. Barthel  
*Laboratoire Surface Du Verre Et Interfaces - Unité Mixte CNRS/Saint-Gobain, Aubervilliers, France*
- 16:30 T48.012 **Crackling Dynamics during the Failure of Heterogeneous Material: Optical and Acoustic Tracking of Slow Interfacial Crack Growth**  
S. Santucci\*, M. Grob, R. Toussaint, J. Schmittbuhl, A. Hansen, K.J. Maloy  
*Oslo University, Oslo, Norway*
- 16:50 T48.010 **Deformation of the Crack Front during Propagation in Some Disordered Medium: Theoretical and Experimental Studies**  
N. Pindra\*, V. Lazarus, J.B. Leblond, J. Schmittbuhl, R. Toussaint  
*UPMC Univ Paris 6, CNRS, UMR 7190, Institute Jean Le Rond d'Alembert, Paris, France*

**T48-S3 - Crackling Noise**

Tuesday July 14, 10:30 -11:50

Westin Hotel - Les Saisons Room

Chair: D. Dalmas, *Unité Mixte CNRS/Saint-Gobain, Aubervilliers, France*

- 10:30 T48.019 **Avalanche Properties in the Elastic Line Creep Evolution**  
X. Illa\*, J. Koivisto, J. Rosti, L. Laurson, M. Alava  
*Helsinki University Of Technology, Hut, Finland*
- 10:50 T48.015 **Probing the Effect of Disorder and Interactions on Crack Growth Dynamics**  
L. Vanel\*, O. Ramos, P.-P. Cortet, S. Ciliberto  
*Université de Lyon, ENS Lyon, France*
- 11:10 T48.008 **Digital Image Correlation and Acoustic Emission Studies of Creep Fracture**  
J. Koivisto\*, J. Lehtinen, J. Rosti, M. Alava  
*Helsinki University Of Technology, Helsinki, Finland*
- 11:30 T48.003 **Aftershocks in Thermally Activated Rupture of Indented Glass**  
S. Ciliberto\*, N. Mallick, S.G. Roux, P. di Stefano, L. Vanel  
*Université De Lyon, ENS De Lyon, CNRS, France*

**T48-S4 - Crack Dynamics**

Tuesday July 14, 15:30 – 16:50

Westin Hotel - Les Saisons Room

Chair: S. Deschanel, *Université de Lyon, INSA-Lyon, CNRS, France*

- 15:30 T48.011 **Depinning Transition in Material Failure**  
L. Ponsou\*, G. Cordeiro  
*California Institute of Technology, Pasadena, USA*
- 15:50 T48.013 **Energetic Aspects of Dynamic Fracture in Glass and Plexiglas**  
J. Scheibert\*, C. Guerra, D. Dalmas, D. Bonamy  
*CEA/IRAMIS/SPCSI, Gif sur Yvette, France*
- 16:10 T48.006 **Morphological Aspects on the Fracture Surfaces in Brittle Materials and their Correlation with Crack Velocity and Acoustic Emission**  
C. Guerra\*, J. Scheibert, D. Dalmas, D. Bonamy  
*CEA/ IRAMIS/ SPCSI/ Group Complex Systems and Fracture, Gif sur Yvette, France*
- 16:30 T48.024 **Transition from Hierarchical to Hexagonal Domains in Fracture Patterns**  
O. Ramos\*, J. Mathiesen, J-C. Géminard, L. Vanel  
*Université de Lyon, ENS Lyon, France*

**T48-S5 – Crack Path****Wednesday July 15, 10:30 – 12:10**

Westin Hotel - Les Saisons Room

Chair: C. Rountree, *CEA, IRAMIS, SPCSI Gif-Sur-Yvette France*

- 10:30 T48.020 **Analysis of Fracture Roughness Using 3D Beam Lattice Systems**  
P. Nukala\*, S. Zapperi, M. Alava  
*Oak Ridge National Laboratory, Oak Ridge, USA*
- 10:50 T48.009 **Transient Damage Spreading and Anomalous Scaling in Mortar Crack Surfaces**  
E. Bouchaud\*, D. Bonamy, L. Ponson, S. Morel  
*Université Bordeaux 1, Talence, France*
- 11:10 T48.021 **Humidity Influence on the Fracture of Glasses at the Nanometer Scale**  
G. Pallares\*, C.L. Rountree, C. Ottina, D. Bonamy, M. Ciccotti, E. Bouchaud  
*CEA, IRAMIS, SPCSI, Gif-sur-Yvette, France*
- 11:30 T48.018 **Fractography and Scaling in Concrete Specimens Broken in Compression and Bending**  
M. Hinojosa\*, A. Varela, V. González, E. Reyes, C. Guerra  
*Universidad Autónoma De Nuevo León, Nuevo León, México*
- 11:50 T48.001 **Statistical Fracture Toughness Analysis of Guiting Limestone Using Disc Shape Test Specimens**  
M.R. Ayatollahi, M.R.M. Aliha, D.J. Smith, M.J. Pavier  
*University Of Bristol, UK*