**International Symposium on Nano and Micro Scale Damage in Metals**

*Utrecht – The Netherlands*

*February 2018*

### Nano and Micro Scale Damage in Metals (Day 1)

**REGISTRATION**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>12:00</td>
<td>Lunch</td>
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**OPENING AND INTRODUCTION**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>13:30</td>
<td>Welcome Speech - Leo Kestens/Jilt Sietsma</td>
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<td>Room 114</td>
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<tr>
<td>14:45</td>
<td>Keynote M. Rethmeier (BAM, D)</td>
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<tr>
<td></td>
<td>Experimental and numerical investigation of hot crack formation during laser beam welding of austenitic stainless steels</td>
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<td>Room 114</td>
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**PARALLEL SESSIONS**

**Session 1**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>13:40</td>
<td>D. Pino Muhoz (ParisTech, FR) - Numerical modeling of ductile failure of heterogeneous microstructures based on mesh adaption within a Level-Set framework</td>
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<tr>
<td>14:00</td>
<td>S. van der Zwaag (TU Delft, NL) - Autonomous repair of creep damage in Fe-Al heterogeneous microstructures based on mesh adaption within a Level-Set framework</td>
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</table>

**Coffee Break**

15:40 Coffee break

**KEYNOTE SPEAKER**

<table>
<thead>
<tr>
<th>Time</th>
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<tr>
<td>16:00</td>
<td>J.-B. Vogt (Université de Lille, FR)</td>
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<td></td>
<td>Fatigue of metallic materials</td>
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<td>Room 114</td>
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**PARALLEL SESSIONS**

**Session 2**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>16:50</td>
<td>P. Verleysen (UGent, BE) - Micro-macro analysis of damage in ductile Discrete Dislocation Plasticity materials</td>
</tr>
<tr>
<td>17:20</td>
<td>T. Katiyar (RUG, NL) - On the effective mobility of BCC dislocations in 2D- Discrete Dislocation Plasticity</td>
</tr>
<tr>
<td>17:50</td>
<td>A. Mohammadpour (TU/e, NL) - Thermo-mechanical fatigue analysis of cast iron based on micromechanical modeling</td>
</tr>
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</table>

**Coffee Break**

18:40 Coffee break

**Final Day 1**

18:20 End Day 1
International Symposium on Nano and Micro Scale Damage in Metals
Utrecht – The Netherlands
February 2018

Nano and Micro Scale Damage in Metals (Day 2)

REGISTRATION
09:00 Coffee & Registration

KEYNOTE SPEAKERS
09:15 P. Van Houtte (KU Leuven, BE)
Damage and microstructure of in-field loaded rails from macro to nano-scale
Room 114

BREAK
10:00 Coffee Break

PARALLEL SESSIONS
10:15 Session 5 Modelling 2
- Fatigue and ductility of high manganese sheet steels
- Elastic-plastic stress-strain curve model and experimental validation
Room 115

Session chair: Name (tbd)

10:30 Session 6 Advanced High Strength Steels 1
- Strength vs Ductility
- Modelling of interface decohesion in steel
Room 114

Session chair: Name (tbd)

11:10 Lunch

KEYNOTE SPEAKER
11:30 F. Archie (MPIE, DE)
Advanced High Strength Steels 2
Session 8

Session chair: Name (tbd)

12:15 Lunch Break

PARALLEL SESSIONS
13:15 Session 9 Modelling 2
- Damage mechanisms in multiphased steels
- Fracture toughness measurement of a maraging steel
Room 114

Session chair: Name (tbd)

14:00 Session 10 Characterisation cond.
- Investigation of cyclic plasticity: a mesoscopic tool kit
- Investigation of anisotropic damage evolution in dual phase steels
Room 114

Session chair: Name (tbd)

15:40 Session 11 Characterisation cond.
- Optimising EBSD analysis of deformation microstructures
- Design of anisotropic damage evolution in dual phase steels
Room 114

Session chair: Name (tbd)

16:30 Session 12 Characterisation cond.
- Understanding micro-crack initiation in DP-steels
- Nano-scale precipitation in high strength nitrided maraging steel
Room 114

Session chair: Name (tbd)

21:30 End Day 2

KEYNOTE SPEAKER
21:30 M. Aarnts (Company)
Optimizing edge ductility and fatigue by increasing damage resistance with the introduction of novel hot-rolled steels for automotive chassis

Poster Presentation

M. Aarnts (Company): Optimizing edge ductility and fatigue by increasing damage resistance with the introduction of novel hot-rolled steels for automotive chassis
Content

Symposium programme

Keynote Abstracts
Strength and ductility of high manganese sheet steels
W. Bleek, X. Guo, M. Madivala

Damage and microstructure of in-field loaded rails from macro to nano-scale
R. Petrov, J. Wu, A. Kumar, M. Naemi, Z. Li and J. Sietsma

Experimental and numerical investigation of hot crack formation during laser beam welding of austenitic stainless steels
N. Bakir, A. Gumenyuk, M. Rethmeier

Including damage modelling into crystal plasticity simulations using the Düsseldorf Advanced Material Simulation Kit DAMASK
F. Roters, L. Sharma, M. Diehl, P. Shanmugam

Effect of crystallographic orientation and stored dislocations of individual grains on macroscopic failure in deep drawing
P. Van Houtte

An overview of rolling contact fatigue developments in bearing steels
E. Vegter

Fatigue of metallic materials
J.-B. Vogt

Contributed Abstracts
Optimizing edge ductility and fatigue by increasing damage resistance with the introduction of novel hot-rolled steels for automotive chassis
M. Aarnts, A. Vass, B. Poot, L. Beers, M. de Bruine, J. Sengers, and A. Rijkenberg

Study of weld solidification cracking in automotive advanced high strength steels
G. Agarwal, H. Gao, I. M. Richardson and M. J. M. Hermans

Understanding micro-crack initiation in DP-steels through an integrative characterization approach
F. Archie, S. Zaefferer

Investigation of anisotropic damage evolution in dual phase steels
E.E. Aşk, E.S. Perdahçioğlu, A.H. van den Boogaard

Investigation of cyclic plasticity: a mesoscopic toolkit
J. Bouquerel, J.-B. Vogt
Dynamic fracture of a pipeline steel  
S. Chandran, P. Verleysen, J. Lian, W. Liu, S. Cooreman, S. Münstermann

Optimising EBSD analysis of deformation microstructures  
R. de Kloe

On the effect of hydrogen on vacancy diffusion  
S. Echeverri Restrepo and A. T. Paxton

Fracture toughness measurement of a martensitic thin sheet of a 3rd generation advanced high strength steel after a baking cycle  
P. Eftekharimilani, T. A.C. Riemslag, M.J.M. Hermans, I.M. Richardson

Modelling of interface decohesion in steel  
A. Elzas and B. Thijsse

Prediction of damage initiation in bainitic steels using crystal plasticity homogenization models  
J. Galán-López, B. Shakerifard and L. A.I. Kestens

Micro-mechanical study of rolling contact fatigue in railway steels  
O. Hajizad, Z. Li and R. Dollevoet

Microstructure and fracture mechanisms in quenching and partitioning steels  
J. Hidalgo, C. Celada-Casero, M.J. Santofimia

Influence of martensite content on hole expansion in bainitic steels  
F. Hisker, D. Jorge-Badiola, M.C. Taboada, S. van Bohemen

On the effective mobility of BCC dislocations in 2D-discrete dislocation plasticity  
T. Katiyar, E. van der Giessen

A study on microstructural evolution of white and brown etching layers in pearlitic steels  
A. Kumar, M. Herbig, R. Petrov, J. Sietsma

Non-destructive subsurface analysis of Ar, He, Ne and H-filled nanobubbles in copper and tungsten  
O. Kurnosikov

Statistical in-situ analysis of ductile damage mechanisms in DP800 Dual-Phase Steel  

Lifetime and damage characterization of compacted graphite iron under thermomechanical fatigue  
E. Lopez, S. Ghodrat and L.A.I. Kestens

Damage mechanisms in multiphased steels with a bainitic matrix under various mechanical loading paths  
P. Martin, J. Chottin, K. Unruh, O. Kapikranyan, E. Hug

Thermo-mechanical fatigue analysis of cast iron based on microstructural modelling  
A. Mohammadpour, V. G. Kouznetsova and M.G.D Geers

Development of gas nitrided 18Ni maraging steel to optimize the very high cycle fatigue properties  
B. Pennings, D. Tran, U. Karr, H. Mayer

Numerical modeling of ductile failure of heterogeneous microstructures based on mesh adaption within a Level-Set framework  
D. Pino Muñoz, M. Bernacki, V. Trejo Navas, M. Shakoor, P.-O. Bouchard

Damage and fracture modelling and experimental validation  
M. Sadhinoch, E.H. Atzema, E.S. Perdahchioglu and A.H. van den Boogaard

Combining a bainite transformation and an iso-work stress-strain curve model  
S. Schreiber

Banding and its topological effect on micro-mechanisms of damage initiation in low silicon bainitic steels under static loading condition  
B. Shakerifard, J.G. Lopez and L.A.I. Kestens

Some aspects of the damage in a carbidere free bainitic steel deformed in tensile mode  
M.C. Taboada, D. Jorge-Badiola, F. Hisker, I. Gutiérrez

Effect of the austenite yield strength on the bainite lath thickness  
S. van Bohemen

Autonomic repair of creep damage in Fe-X model alloys for creep resistant steels  
S. van der Zwaag, H. Fang, C. Versteylen and N.H. van Dijk

Micro-macro analysis of damage in ductile materials  
P. Verleysen

Nano-scale precipitation in high strength nitrided maraging steel  
J. Wu, A. Verdiere, J. Sietsma, M. D. Tran, B. Penning and R. H. Petrov

Optimizing combination of elongation and edge ductility through microstructure control in hot rolled bainitic steel  
K. Zhu, S. van Bohemen, D. Jorge-Badiola

Organizing Committee
Dynamic fracture of a pipeline steel

S. Chandran\textsuperscript{a}, P. Verleysen\textsuperscript{a}, J. Lian\textsuperscript{b}, Wenqi Liu\textsuperscript{b}, S. Cooreman\textsuperscript{a}, S. Münstermann\textsuperscript{b}

\textsuperscript{a}Ghent University, Belgium, MST-DyMa Lab, EEMECS department
\textsuperscript{b}RWTH Aachen University, Germany, Steel Institute
\textsuperscript{c}OCAS, ArcelorMittal Global R&D Ghent, Technologiepark 935, 9052 Zwijnaarde, Belgium

The occurrence of a crack propagating along a pipeline is a catastrophic event, which involves both economic losses and environmental damage. Therefore, the study of the fracture initiation and propagation properties of a pipeline is an essential part of its integrity assessment. Fracture prediction, however, is a challenging task, since it requires knowledge of the interaction between the dynamic forces driving crack growth, and the resistance forces opposing fracture propagation. Moreover, plenty of material properties should be taken into account. Aiming at a better understanding of the plastic hardening, damage and fracture properties of an API X70 pipeline steel, and how these are affected by the strain rate, in present contribution, a comprehensive set of test results is presented. The influence of loading conditions is studied by performing static and dynamic experiments with different stress triaxialities: tensile tests on smooth and notched samples and compression tests on cylindrical samples. The static tensile tests are carried out on a conventional electromechanical test device. The high strain rate behaviour of API X70 pipeline steel is characterised using Split Hopkinson Bar (SHB) tensile setup. The material was found to combine high strength with relatively high ductility. Positive strain rate influence was observed in terms of strength and relative increase in deformation capacity primarily in the transition from static to dynamic rates of loading. Induced high stress triaxialities in the notched samples gave rise to higher initial axial force levels resulting in a detrimental effect on the strain capacity of the material. The stress and strain distributions close to the fracture, including the loading path up to the onset of fracture are analysed using finite element modelling. As such, the study aims at providing data needed for both fundamental material research and constitutive material modelling.