

ESS Science Symposium on physical simulations of processes in engineering materials with in-situ neutron diffraction/imaging

November 15-16, 2012

Vila Lanna, Prague, Czech Republic

Organisers

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Aim of the symposium:

The aim of the symposium is to review the technical feasibility and scientific potential of the idea to build dedicated environment for physical simulation of processes in engineering materials (electro-thermo-mechanical testing system capable of extreme heating/cooling/loading rates - Gleeble®) with in-situ neutron diffraction/imaging at European Spallation Source currently under construction in Lund, Sweden.



Scope:

Physical properties of advanced engineering materials depend, besides chemical and phase composition, on its microstructure established during its preparation and processing. This is why **numerical simulation of microstructure and physical property evolution during material processing is at present highly demanded from industry**. Simulations of true industrial processes is however extremely complicated and the numerical results must be continuously confronted with experiments on industrial facilities.

Physical simulation of materials processing involves laboratory reproduction of the thermal and mechanical processes that the material is subjected to in the actual fabrication, processing or end use.

A small sample of the actual material is used in the simulation (testing on a dedicated electro-thermo-mechanical rig capable of application of high temperatures, complex loads and extreme heating/cooling/loading rates) and the material follows the same thermal and mechanical profiles as in the full scale process. When the results are accurate, they can be readily transferred from the laboratory to the full scale production process.

Recently fast developing neutron diffraction/imaging methods and facilities can be used to follow evolution of microstructure in engineering materials during thermal and mechanical loads. Since recently, these “In-situ engineering experiments” are steadily gaining in importance and frequency at large scale neutron facilities. The underlying idea behind the proposition of this symposium is **to explore the possibilities to use and further upgrade the existing neutron diffraction/imaging methods to follow the evolution of microstructure, stress, texture during extreme thermomechanical conditions used in “physical simulations”** introduced above. Physical simulations combined with in situ neutron diffraction studies thus extremely simplifies development and verification of the results of numerical simulation of material processing. Since reliable simulation of material processing may significantly decrease the cost and time necessary for development of industrial processing technologies, vital interest from industry is anticipated.

Scientific and industrial potential of the idea of physical process simulations with in-situ neutron diffraction/imaging will be discussed among the Symposium participants forming **potential nucleus of the future ESS user community to be involved in Physical Simulations with Neutrons**.

Venue and social activities:

Symposium will be organized as a two days workshop to be held in Vila Lanna facility in Prague, Czech Republic. Welcome event will be organized on November 14 and workshop dinner on November 15. Accommodation for ~25 participants will be offered in Vila Lanna.

Vila Lanna, V Sadech 1, 160 00, Prague , Czech Republic,
<http://data.vila-lanna.ssc.avcr.cz/index.html>



Tentative workshop agenda:/2days/

Workshop attendance: Speakers (~20) from 3 independent research communities (numerical modeling, physical simulations, engineering research using neutron (X- ray) diffraction/imaging) and from metal processing industry will be invited.

Introduction

- Welcome
- Presentation of the aim and scope of the workshop

ESS update

- Outline of ESS progress – keynote lecture
- Engineering research at ESS

Neutron and X-ray diffraction studies of engineering materials (methods, facilities, results)

- Evolution of microstructure in engineering materials exposed to thermomechanical loads – keynote lecture
- Invited and contributed talks + final discussion

Simulation of processes in engineering materials exposed to extreme condition (industrial demands, models, results)

- Theoretical model simulation of microstructure evolution, stresses and strains in materials exposed to thermomechanical processing – keynote lecture
- Invited and contributed talks + final discussion

Physical simulation of processes in engineering materials using GLEEBLE (facilities, industrial demands, results)

- Physical simulations using Gleeble® systems – keynote lecture
- Adaptation of Gleeble® for synchrotron research – installation in Brazil
- Invited and contributed talks – case examples + final discussion

Physical simulation of processes in engineering materials with in-situ neutron (X-ray) diffraction/imaging

- Invited and contributed talks on physical simulation – case examples
- Presentation explaining the idea of **Physical simulations with in-situ neutron diffraction/imaging at ESS** – keynote lecture
- Roundtable discussion of the idea of physical process simulations with in-situ neutron diffraction/imaging /1h/

Complex-environment engineering diffractometer (CEED) for ESS

- Current status of the planning for CEED diffractometer

Workshop closure