PAUL SCHERRER INSTITUT

LNM Seminar

11 May 2017, 15.00 h OHLD/011

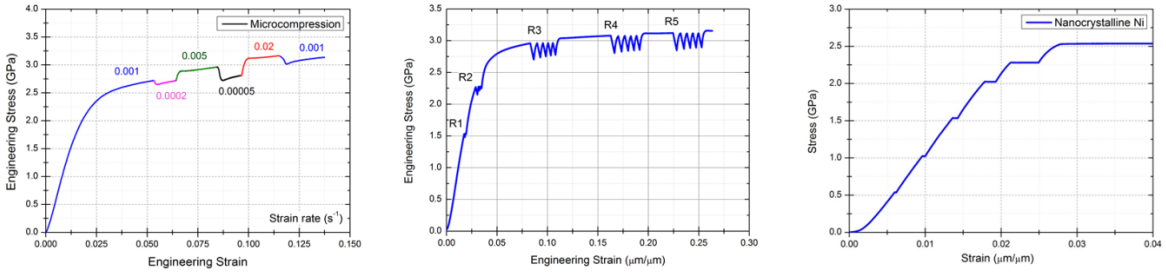
ADVANCING FRONTIERS OF MICRO/NANOMECHANICS: IN-SITU VARIABLE TEMPERATURE, TIME DEPENDENT PLASTICITY, FRACTURE AND FATIGUE PROPERTIES AT SMALL LENGTH SCALES

Gaurav Mohanty, Johann Michler

Laboratory for Mechanics of Materials and Nanostructures, EMPA, Thun

Nano-mechanical measurements offer exciting possibilities for studying fundamental deformation mechanisms by accelerated testing of materials at small length scales. However, majority of such studies, usually involving nano-indentation, are performed at slow strain rates and under ambient conditions. This talk will present case studies on materials with high defect densities, e.g. nano-crystalline and metallic multi-layered systems, to highlight the recent advances in the field particularly in terms of the range of in-situ techniques, material properties, test temperatures and strain rates being explored.

The high spatial resolution of nano-mechanical data enables studying composition, phase and microstructural gradients to develop a detailed understanding of the graded materials and such approaches are relevant to irradiated materials being studied at PSI. Examples of in-situ tests performed using SEM [1], EBSD [2] and synchrotron x-rays [3] will be presented to highlight the combination of structural and micro-analytical techniques with mechanical deformation data to uncover operative deformation mechanism(s). Recent advances in high temperature, cryogenic temperature and high strain rate instrumentation and test techniques developed at EMPA will be introduced. Micro-pillar high cycle fatigue (going up to 10 million cycles) and time dependent plasticity [4, 5] (creep, stress relaxation and strain rate sensitivity) studies on nano-crystalline metals will be presented. Finally, current state of the art and future directions of research will be discussed.



[1] Wehrs J. et al, Mohanty G., JOM 2015;67:1684-93
[2] Ast J. et al, Mohanty G., Materials & Design 2017;117:265-6.
[3] Gamcová J. et al, Mohanty G., Applied Physics Letters 2016;108:031907.
[4] Mohanty G. et al, Philosophical Magazine 2015;95:1878-95
[5] Mohantya G. et al, J Mater Res 2016;31:1086.