Session:
Extreme pressure and temperature research in the field of Materials for Energy and Transport Technology

19.10.2020 – 21.10.2020

DESY, Hamburg, Germany

Abstract

Many of the physical phenomena including superconductivity, thermoelectricity, ferroelectricity, structural and the correlated electronic and magnetic phase transitions are the key tools for the designing of novel functional materials and for exploration of the new frontiers of material science. Considering real world systems, nature and driving forces behind those phenomena are complex and have not been fully understood. Meanwhile, experimental studies at high-pressure and extreme (high or low) temperatures help to enhance fundamental and applied knowledge about the related processes. This session will be devoted to the science, instrumentation and the essential X-ray techniques related to the exploration of strongly correlated systems and physical phenomena at extreme conditions. The main focus of the session will be directed to new possibilities and future experiments which might become available at the DLSR PETRA-IV. Altogether, the planned upgrade will make PETRA-IV the most brilliant synchrotron source at high energies, providing the science communities with new groundbreaking experimental facilities dedicated to the exploration of strongly correlated phenomena at extreme conditions. We discuss the new science possible due to the small source size and the increase of the X-ray beam coherence.

Techniques

- X-ray diffraction (focused and unfocused, on powders and single crystals)
- Scattering on amorphous and liquid materials
- Absorption Contrast Imaging (Radiography)
- Phase Contrast Imaging
- Time-resolved Micro-tomography
- Near-field and Far-field High Energy Diffraction Microscopy
- Coherent Bragg Diffraction Microscopy
- Scanning transmission X-ray Microscopy
- Combined spectroscopy (XES, XANES, EXAFS, XRS, fluorescence, etc.) and X-ray diffraction
- Ptychography
- Nuclear forward scattering
- Nuclear Inelastic Scattering
- Synchrotron Mössbauer source

Session 1: **Extreme pressure and temperature research in the field of Materials for Energy and Transport Technology** ***Chair:***		
Time	**Title**	**Presenter**
20 min	Extreme pressure and temperature research at PETRA IV	H. P. Liermann (DESY)
25 min	Benefits at PETRA IV for high-pressure research using the LVP: synthesis of novel nitrides and fullerenes	M. Sieber (Uni. Potsdam, GFZ)
25 min	Materials Discovery and Characterization under extreme static high pressure and temperature conditions using XRD and imaging	C. Prescher (Uni. Freiburg, DESY)
25 min	Shaping the future of extreme condition material sciences with a unique synergy of diffraction and spectroscopy	D. Laniel (BGI)
25 min	Opportunities for dynamic compression science at synchrotrons	D. Kraus (Uni. Rostock)

Session:

Extreme pressure and temperature research in the field of Earth Sciences

02.11.2020 - 04.11.2020

DESY, Hamburg, Germany

Abstract

In situ studies of Condensed Matter at pressure and temperature conditions found in planetary bodies, such as the Earth, and Warm Dense Matter observed in giant planets are at the forefront of advancing research in the field of natural sciences. Samples are illuminated with high-energy synchrotron X-ray beams in diamond anvil cells (DAC), large volume presses (LVP) and dynamic Laser-driven shock devices to investigate their structure, physical properties and kinetics of transformational processes using X-ray diffraction, spectroscopy and imaging techniques. Current techniques used at PETRA III will be enhanced and new techniques added, such as time-resolved microtomography, phase contrast, coherent Bragg diffraction imaging, ptychography, and synchrotron Mössbauer spectroscopy. PETRA IV will break new ground by enabling the study of Earth materials at length and time scales of several orders of magnitude such as probing micron-sized crystallites in a larger bulk rock experiencing different pressure, temperature and stress states. Using the LVP, grain boundary structures and processes, which play a critical role in mantle dynamics and melt transport, can be resolved. Using the DAC, meteorite impacts can be simulated and tiny samples at pressures present in giant planets can be investigated. These studies will all be enabled through PETRA IV that delivers a small round (focused) beam at high energies (>14 keV to 100 keV), combined with its high coherence, and most importantly as a consequence of the highest brilliance at high energies compared to other DLSR.

Techniques

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- Near-field and Far-field High Energy Diffraction Microscopy
- Coherent Bragg Diffraction Microscopy
- Scanning transmission X-ray Microscopy
- Spectroscopy (XES, XANES, EXAFS, RAMAN, fluorescence, etc.) and X-ray diffraction
- Ptychography
- Nuclear forward scattering
- Nuclear Inelastic Scattering
- Synchrotron Mössbauer source

Session 1: **Extreme pressure and temperature research in the field of Earth Sciences** ***Chair:***		
Time	**Title**	**Presenter**
20 min	Scientific Instrument Proposal for **LVP Instruments** in the field of Earth Sciences	M. Sieber (Uni. Potsdam, GFZ)
20 min	Scientific Instrument Proposal for a **high-P, high-T, x-ray diffraction and imaging microscope** in the field of Earth Sciences	C. Prescher (Uni. Freiburg, DESY)
20 min	Scientific Instrument Proposal for a **high-P and T, x-ray spectroscopy and diffraction instrument** in the field of Earth Sciences	T. Meier (BGI)
20 min	Scientific Instrument Proposal for **x-ray Raman instrument** in the field of Earth Sciences	C. Sternemann (TU Dortmund)
20 min	**Nuclear Resonance Scattering** at extreme conditions - implications for Earth Sciences	I. Kupenko (Uni. Münster)
20 min	Scientific Instrument Proposal for a **Dynamic Compression Microscope** in the field of Earth Sciences	D. Kraus (Uni. Rostock)