HPSTAR Summer Camp 2015

July 13 – 17, 2015

Shanghai • China

Abstract Book

http://www.hpstar.ac.cn/

Summer Camp 2015

HPSTAR Summer Camp 2015 is scheduled from July 13 to 17 in Shanghai. More than 17 renown scientists from both HPSTAR and worldwide will offer exciting talks regarding both high-pressure research and general science knowledge. All students are encouraged to join this camp, who will not only enjoy an opportunity to learn from established scientists but also have a chance to participate in pre-interview for admission to HPSTAR Graduate Degree Programs.

About HPSTAR

HPSTAR (Center for High Pressure Science & Technology Advanced Research) is a research institution of high-pressure sciences led by Dr. Ho-Kwang Mao. In September 2012, as one of the Innovative Teams supported by China's Top 1000Talent Program, HPSTAR was first established in Shanghai, followed by two new laboratories in Changchun and Beijing. In 10 years, HPSTAR is projected to grow to 90 faculty members and 600 staff including graduate students, postdocs, visiting scientists, engineers and administrative personnel.

The research areas of HPSTAR include: high-pressure physics, high-pressure chemistry, super-hard materials, Earth & planetary interiors, high-pressure technology, high-pressure photon science, high-pressure nano science, high-pressure functional materials, and high-pressure energy science.

The mission of HPSTAR is to become a world-leading center in high-pressure research and to impact multidisciplinary physical sciences. HPSTAR provides ample research funding, advanced facilities, and an open, liberal, collaborative research environment. The Scientists of HPSTAR have the total freedom to define their research goals, paths, teams, and collaborations in China and abroad. They will be able to fully devote their time, efforts, and creativity to pursue individual scientific dreams.

Schedule

Day 1 | Monday, July 13, 2015		
Morning Session Chair: Wenge Yang		
8:30-9:00AM	Registration	Room 410
9:00-9:10AM	Opening address from **Ho-kwang Mao** (Director, HPSTR, China)	Room 410
9:10-9:30AM	Introduction by **Wenge Yang** (HPSTAR, China)	Room 410
9:30-10:20AM	**Ho-kwang Mao** (Director, HPSTAR, China): Overview of High Pressure Science	Room 410
10:20-10:30AM	**COFFEEBREAK**	Room 409
10:30-11:20AM	**Bin Chen** (HPSTAR, China): About HPSTAR	Room 410
11:20-12:00PM	**Yuelin Li** (Argonne National Laboratory, USA) Time Resolved X-ray Science: Revealing Hidden Physics in Complex Oxides	Room 410
12:00-2:00PM	**LUNCH**	Cafeteria
Afternoon Session Chair: Lin Wang		
2:00-2:45PM	**Xiao-Jia Chen** (HPSTAR, China): High Pressure Physics	Room 410
2:45-3:30PM	**Lin Wang** (HPSTAR, China): Frontier Research in High Pressure Physics	Room 410
3:30-3:45PM	**COFFEEBREAK**	Room 409
3:45-4:30PM	**Haozhe Liu** (HPSTAR, China): Introduction to High Pressure Science and Technology: The Brief History and Couples Fundamental Concepts	Room 410
4:30-5:15PM	**Li Zhang** (HPSTAR, China): Exploring the Earth's Interior Using Synchrotron X-ray	Room 410
5:15PM	**DINNER**	
7:00-8:00PM	Discussion with scientists | **Jiuhua Chen** Informal Discussion: A story of success	Room 410
Day 2 | Tuesday, July 14, 2015		
Morning Session Chair: Xiao-Jia Chen		
9:00-9:45AM	**Wenge Yang** (HPSTAR, China): Novel Materials under High Pressure	Room 410
9:45-10:30AM	**Hao Yan** (HPSTAR, China): Nanomaterial under High Pressure	Room 410
10:30-10:45AM	**COFFEEBREAK**	Room 409
10:45-11:30AM	**John Plummer** (Nature Materials, UK): Publishing in Nature Journals	Room 410
11:30-11:50AM	**Group-Photo**	Outdoor
11:50-1:00PM	**LUNCH**	Cafeteria
1:00-2:00PM	Discussion with scientists | **Howard Sheng, Wenge Yang**	Room 410
2:00-5:30PM	Lab Tour | **Dayong Tan**	HPSTAR Lab and SSRF beamline
5:30PM	**DINNER**	
7:00-9:00PM	Discussion with scientists | **Bin Chen, Zhiqiang Chen**	Room 410

Day 3 | Wednesday, July 15, 2015		
9:00-11:00AM	Teaching Physics | **Wenge Yang, Xiao-Jia Chen, Lin Wang** Materials | **Bin Chen, Hengzhong Zhang**	Room 410
11:00-11:45AM	**Jay Bass** (University of Illinois, US): Sound Velocity Measurements in the Diamond Anvil Cell with Brillouin Scattering and Laser Heating: Investigating the Chemistry and Structure of Earth's Mantle	Room 410
11:45-1:00PM	**LUNCH**	Cafeteria
1:00-2:00PM	Discussion with scientists | **Lin Wang**	Room 410
2:00-5:30PM	Pre-Interview | **Yiwen Zhang**	Room 201 Room 409 Room 410
5:30PM	**DINNER**	
Day 4 | Thursday, July 16, 2015		
Morning Session Chair: Haozhe Liu		
9:00-9:45AM	**Jung-Fu Lin** (HPSTAR, China): Deciphering the Enigma of Planetary Interiors	Room 410
9:45-10:30AM	**Hengzhong Zhang** (HPSTAR, China): Pressure Induced Changes in Material Structures and Properties	Room 410
10:30-10:45AM	**COFFEEBREAK**	Room 409
10:45-11:30AM	**Simon Redfern** (University of Cambridge, UK): Neutron Scattering at High Pressure and Temperature: Insights into Structure and Dynamics	Room 410
11:30-1:00PM	**LUNCH**	Cafeteria
Afternoon Session Chair: Jung-Fu Lin		
1:00-2:00PM	Discussion with scientists | **Jung-Fu Lin**	Room 410
2:00-2:45PM	**Sean Shieh** (Western University, Canada): Strength and Elasticity of Materials under Pressure	Room 410
2:45-3:30PM	**Zhonghou Cai** (Advanced Photon Source, US): X-ray Scanning Micro/Nanoprobe and Application in Materials Science	Room 410
3:30-3:45PM	**COFFEEBREAK**	Room 409
3:45-4:30PM	**Kuo Li** (HPSTAR, China): Unveiling High-Pressure Chemistry	Room 410
4:30-5:30PM	General Discussion	PI's office
5:30PM	**DINNER**	
7:00-8:00PM	Discussion with scientists | **Yanzhang Ma**	Room 410
Day 5 | Friday, July 17, 2015		
9:00-11:00AM	Teaching: Earth Science | **Li Zhang, Jung-Fu Lin** Chemistry | **Kuo Li, Hao Yan**	Room 410
11:00-11:45AM	**Andrzej Katrusiak** (Adam Mickiewicz University in Poznań, Poland): High-Pressure Crystallization	Room 410
11:45-1:00PM	**LUNCH**	Cafeteria
1:00-2:00PM	Discussion with scientists | **Kuo Li**	Room 410
2:00-5:30PM	**Closing Ceremony | Jiuhua Chen**	Room 410
5:30PM	**DINNER**	

Abstract:

Overview of High Pressure Science synopsis
Ho-kwang Mao

Dr. Ho-kwang Mao was born in Shanghai in 1941. He received his BS from National Taiwan University in 1963 and obtained his MS in 1966 and PhD in 1968 from the University of Rochester, Rochester NY. From 1968-1972, Mao did his postdoctoral research at the Geophysical Laboratory of the Carnegie Institution of Washington (CIW). From then on Mao has spent his career at the Geophysical Laboratory as a Senior Staff scientist. In May of 2012, Dr. Mao was under the "Top 1000-Talent Plan" in China and became the director of the Center for High Pressure Science and Technology Advanced Research (HPSTAR).

Mao is one of the most prolific users of the diamond anvil cell for research at high pressures. Although at the time the claim was controversial, his work with Peter M. Bell is now generally accepted as being the first verified static pressure in excess of 1 Megabar. He received the Mineralogical Society of America Award (1979), the P. W. Bridgman Award, from the AIRAPT International (1989), the Arthur L. Day Prize from the United States National Academy of Sciences (1990), the Roebling Medal from the Mineralogical Society of America (2005), the Gregori Aminoff Prize from the Royal Swedish Academy of Sciences (2005), the Balzan Prize for Mineral Physics (with Russell J. Hemley) (2005), and the Inge Lehmann Medal from the American Geophysical Union (2007). He was also elected as the Fellow of the Mineralogical Society of America (1979), Fellow of the American Geophysical Union (1987), Fellow of the American Physical Society (1994), Fellow of the Geochemical Society (1996), Member of the United States National Academy of Science (1993), Academician of the Academia Sinica, Taiwan (1994), Foreign Member of the Chinese Academy of Sciences (1996), and Foreign Fellow of the Royal Society of London (2008). He has published more than 800 papers, including more than 70 papers published in Nature and Science.

Summary of High Pressure Science
Chen Bin

Dr. Bin Chen obtained his PhD degree in physics and engineering from the University of Missouri-Kansas City in 2001. Then he joined CREOL of University of Central Florida (2002-2004) and University of California, Berkeley (2004-2008) as a postdoc and research scientist. Since 2008, he is the beamline scientist of the Advanced Light Source, Lawrence Berkeley National Laboratory. Dr. Chen was awarded the "1000-Talent Plan" in 2015, and he currently is a staff scientist and director, Shanghai Laboratory of HPSTAR.

Dr. Chen's research focuses on high pressure physics, nano science and high power laser physics. He and his co-workers first observed pressure-induced dislocation activity in 3nm nanocrystals. They also obtained important findings on the ductility of ceramics and the size effect on the elastic/plastic deformation and phase transition of nanocrystals. He has published more than 50 articles in Science, Physical Review Letters, Geophysical Review Letters and other international journals.

Condensed Matter Frontier Research for Better Daily Life
Xiao-Jia Chen

Abstract: When taking the Maglev to leave Pudong airport and using your iPhone to tell your schedule, you probably did not realize how modern condensed matter frontier research has already affected our daily lives. Recent breakthroughs in the studies of magneto-resistance effects, magneto-electric coupling, thermoelectric performance, and superconductivity have been bringing rather rich and attractive pictures for our future lives. In this talk, I will introduce some key events and important aspects of such studies with emphasis on the role of pressure in the condensed matter frontier research.

Bio: Dr. Xiao-Jia Chen received his PhD from Zhejiang University, China in 1997. He worked as a research scientist at the Geophysical Laboratory of the Carnegie Institution of Washington (CIW). He was awarded the "1000-Talent Plan" in 2013, and has joined HPSTAR since January 2014 as a staff scientist.

Dr. Chen's research focuses on the superconducting transition in Dense Solids under high-pressure/low temperature, the theory and experimental research of complex electronic behavior, superconductivity of copper oxide and other materials under high-pressure, etc. Dr. Chen has published more than 90 papers including 2 papers published in Nature, 4 in PNAS, and 30 in Phys. Rev. Lett. and Phys. Rev. B.

Frontier Research in High Pressure Physics
Lin Wang

Abstract: In this talk, frontier research topics in the field of high pressure physics including metallic hydrogen, TPa achievement, emergent physics under ultrahigh pressure and super-hard material etc. will be reviewed.

Bio: Dr. Lin Wang obtained his PhD in condensed matter physics from Jilin University in 2006. From 2007-2010, he did his postdoctoral research at the Geophysical Laboratory of the Carnegie Institution of Washington (CIW). He was then promoted to be a research scientist in 2010. In 2014, Dr. Wang was awarded the "Youth 1000-Talent Plan" and joined HPSTAR as a staff scientist.

Dr. Wang's research interests include emergent physical phenomena in materials at extreme conditions (high pressure, high temperature/low temperature); physics under ultra-high pressure, mechanical properties of minerals and earthquake mechanism, nanoscale materials, strong correlation materials, high pressure related synchrotron x-ray techniques; novel diamond anvil cell high pressure techniques. Dr. Wang has published more than 60 peer-reviewed papers including more than 3 papers published in Science, 1 in Nature, 5 in PNAS, 1 in Phys. Rev. Lett. His work has received more than 1000 citations so far.

Introduction for High Pressure Science and Technology: The Brief History and Couples Fundamental Concepts
Haozhe Liu

Abstract: High pressure techniques (brief history); Pressure calibration; Equation of state (EoS); Cases using synchrotron techniques.

Bio: Dr. Haozhe Liu is a staff scientist in HPSTAR (Changchun). He formed his group as the high-pressure materials physics and mineral physics (MPMP). Dr. Liu's research fields are involved in high pressure science and synchrotron radiation technology, high pressure crystallography etc. His research interests include: structural evolution characterization of crystalline and non-crystalline materials under high pressure, in-situ X-ray 3D imaging technologies for materials under high pressure, and application of synchrotron radiation,

high-energy X-ray diffraction and scattering technologies in extreme high-pressure conditions. In domestic and foreign academic organizations, he is currently the Deputy Director member of Chinese Crystallographic Society Council for Crystalline Materials in Extreme Conditions and a Member of the International Union of Crystallography.

Pressure Induced Changes in Material Structures and Properties
Hengzhong Zhang

Abstract: In this lecture, I will talk about the effect of pressure on material structures. This will include thermodynamics and kinetics of pressure induced phase changes in both bulk and nano materials. The influence of pressure on materials properties, including mechanical and electrical properties, will also be discussed. Lastly, I will show research opportunities in my forming High Pressure Nanoscience Group at HPSTAR.

Bio: Dr. Hengzhong Zhang, born in 1964, is a researcher of University of California - Berkeley at present and will be employed as a staff scientist of HPSTAR to form High Pressure Nanoscience Group. More than 80 articles written by him have been published by various the academic Journals such as Nature, Science, Chem. Rev., JACS, PRL and NanoLett. His articles were quoted over 7,000 times. His research fields include High Pressure Nanoscience, Physical Chemistry, Material Chemistry and Geochemistry. His major research interests cover nano material preparation and representation under high pressure and normal pressure, thermodynamics and kinetics of phase changes in nanocrystalline, non-typical nucleation and oriented attachment and growth, nano structure determination and computational simulation, and the effects of temperature, pressure, and environment on nano structures, properties and processes.

Novel Materials under High Pressure
Wenge Yang

Abstract: During recent decades, high pressure materials research has made tremendous progress and breakthroughs in fundamental understanding and industrial applications, over 200K superconducting critical point materials were reported, inert gas can be formed to compound with other elements, unexpected stable stiochiometries are reported in many systems, not previously considered along with many exotic physical/chemical properties under high pressure, which provide a brand new view of novel materials impacted by a high pressure environment. Over this introduction, you may start to design your own materials and dream about the possibility of forming them under extreme conditions.

Bio: Dr. Wenge Yang received his PhD in condensed matter physics in 1995 from Wuhan University, China. He has been serving as the project manager and research scientist of the High Pressure Synergetic Consortium, Geophysical Laboratory, Carnegie Institution of Washington, located at the Advanced Photon Source, Argonne National Laboratory. He was awarded the “1000-Talent Plan” in 2013, and has joined HPSTAR since January 2014 as a staff scientist.

Dr. Yang’s research interest has focused on microstructure, phase transition, physical property and in-situ characterization under extreme environments. He has developed a series of high pressure research techniques and synchrotron radiation methods for broad material research, which prompt the high pressure research in many research fields and extend to other related area. He has published over 140 papers in high impact journals, including Science, Nature, PNAS, PRL, and JACS. He has been the member of several international professional societies (APS, MRS, AGU, TMS, MSA) and served as chair and session chair in many international conferences.

Dr. Yang has achieved great breakthroughs in the high pressure research using various synchrotron radiation techniques. He has established the 3-D submicron-resolution x-ray structural microscopy, high pressure nano-scale x-ray imaging and diffraction, and multiple probing techniques in energy, timing, and spatial dimensions. All these developments and achievements are a fundamental importance for the static compression science.

Nanomaterials under High Pressure
Hao Yan

Abstract: Nano materials are materials possessing size on the order of a billionth of a meter. They often have unique chemical, physical, and mechanical properties due to either or both finite size effects and the large fraction of surface matter. The high pressure investigations of nanomaterials develop in parallel to the growth of nanoscience either to better understand the properties of nanomaterials or to provide alternative methods for nanostructuration. This talk will give an introduction to the high pressure study of nanomaterials, including nanoparticles, 1-D nanomaterials and other nanomaterials.

Bio: Dr. Hao Yan received his BS from Nanjing University (1995), MS degree from Peking University (2001), and PhD from Kansas State University (2009). He worked at Missouri State University as a postdoctoral researcher and a lecturer. He joined HPSTAR in 2013 as an associate staff scientist.

Dr. Yan's research interests include nanoscience and high pressure physics. He has extensive experience in synthesis and characterization of nanomaterials, with the methods of light scattering, SPM, synchrotron, hydrothermal diamond anvil cell, and etc. His research was published in high-profile journals such as Physical Review Letters, The Journal of Chemical Physics, The Journal of Physical Chemistry C, Langmuir etc.

Publishing in Nature Journals
John Plummer

Abstract: Nature Publishing Group offers various journals for the publication of peer-reviewed articles across the natural sciences. This talk will present an overview of the Nature family of journals, including: 1) criteria for publication, and what the editors are looking for, 2) advice on how to prepare a paper for submission, and 3) the dos and don'ts of scientific publication. The aim of this talk is to improve understanding of Nature journals, and how to prepare and submit a manuscript for consideration.

Bio: Dr. John Plummer earned a Meng degree in materials science and engineering from the University of Sheffield, UK, and remained there for a PhD, investigating metallic glasses. He then moved to Imperial College London as a postdoctoral researcher and to lecture on deformation mechanisms in materials. As an editor, John started with Nature Communications in January 2013, and then joined Nature Materials in October 2014, where he handles manuscripts on structural materials, glasses, high pressure studies and other topics of condensed matter physics. John is based in the Shanghai office.

Sound Velocity Measurements in the Diamond Anvil Cell with Brillouin Scattering and Laser Heating: Investigating the Chemistry and Structure of Earth's Mantle
Jay Bass

Abstract: Seismology gives us the most direct information on the properties of the Earth's interior, in the form of the seismic wave velocities (or acoustic velocities) Vp and Vs. These seismic velocity profiles hold the key to understanding mantle composition, structure, and temperature. One of the goals of high-pressure mineral

physics has been to measure seismic velocities at all pressures and temperatures that are thought to exist in Earth's mantle. This is now possible with recent experimental advances.

This talk will describe a newly developed experimental method of measuring Vp and Vs in materials at high pressure and very high temperature simultaneously. This allows us to measure seismic velocities at the pressure-temperature conditions in the mantle. Velocities are measured with the technique of Brillouin light scattering, pressure is produced by a diamond-anvil cell, and samples at high pressure are heated with a CO2 laser. Another laser beam is used to probe the sample, and scattered light is analyzed. Measured frequency shifts gives Vp and Vs. The entire elastic modulus tensor, Cij, can be measured on single crystal, giving velocity anisotropy, which can be the key to understanding dynamic flow in the mantle. This technique may allow us to understand the chemical composition and thermal state of the mantle to a high degree of certainty that was not possible before.

Bio: Prof. Jay Bass (Ralph E. Grim Professor) is professor of the Department of Geology, University of Illinois, US. His research interests are: Chemistry of the Earth's interior, measurements of the sound velocities and elastic properties of solids and fluids by Brillouin spectroscopy and inelastic X-ray scattering, Raman scattering, diamond-anvil high-pressure research, laser heating, equations-of-state of minerals and high-pressure phases, phase transitions, shock wave studies of core materials; phase equilibrium studies at high P&T, crystal structure analyses by XRD; point defect chemistry, ceramic engineering, high temperature fracture toughening, properties of ferroelectrics and "smart" or "adaptive" materials, the structural states of amorphous materials, polyamorphism, and high-temperature viscoelastic properties.

Deciphering the Enigma of Planetary Interiors
Jung-Fu Lin

Abstract: In this presentation, I will discuss the outstanding enigma of planetary interiors that can be addressed using multidisciplinary research results including high-pressure experiments, theoretical calculations, seismic observations and geodynamic modeling. Planetary interiors are naturally subject to extreme pressure-temperature conditions that can significantly affect materials' physics and chemistry well beyond our traditional understanding. These properties in turn contribute to chemical, magnetic, and seismic signatures that one may observe at the very surface of each given planet. For example, the magnetic field of the Earth that is generated via the thermally-powered convections of the liquid outer core could be understood through deciphering the thermal transport properties of the constituting iron alloy at the extreme conditions of the region. On the other hand, recent planetary explorations has discovered exoplanets and their satellites that call for exploratory efforts in high pressure materials research. This lecture will focus on identifying forefront scientific research topics in planetary science that can be potentially tackled using advanced synchrotron X-ray and laser spectroscopic techniques coupled with high-pressure diamond anvil cells.

Bio: Dr. Jung-Fu Lin, born in 1968, received his BS and MS degree from National Cheng-Kung University, Taiwan in 1992 and 1994, and received a PhD in 2002 from The University of Chicago. He has been working as a research and teaching assistant at the Department of Earth Sciences, National Cheng-Kung, Taiwan (1992-1994), research assistant at the Inst. of Earth Sciences, Academia Sinica, Taiwan (1996-1997), research and teaching assistant at the University of Chicago (1997-2002), Carnegie Postdoctoral Fellow in Carnegie Institution of Washington (2002-2003), research scientist in Carnegie-DOE Alliance Center (CDAC), Geophysical Laboratory, Carnegie Institution of Washington (2003-2005), Lawrence Livermore Fellow in Lawrence Livermore National Laboratory (2005-2008), and assistant professor in the Department of Geological Sciences in Jackson School of Geosciences, The University of Texas at Austin (2008-2013). He is Affiliated Faculty in Texas Materials Institute, The University of Texas at Austin and Associate Professor in Department of

Geological Sciences, Jackson School of Geosciences, the University of Texas at Austin since 2013. He has joined HPSTAR since June, 2014 as a staff scientist, and was awarded the “1000-Talent Plan” in 2015.

Dr. Lin’s research focuses on the Earth’s deep interior and planet science, diamond anvil cell high pressure techniques, laser-heating high temperature technique, energy materials, the recovery and reuse of CO2 etc. He has published over 100 papers in high impact journals, including Nature, Science, Phys. Rev. Lett., Proc. Natl. Acad. Sci., etc. He received Honor Member of Phi Tao Phi Society, Taiwan in 1993, and was elected as fellow of Mineralogical Society of America since 1997, American Geophysical Union since 1997, American Institute of Physics since 1997, and COMPRES since 2008.

Exploring the Earth’s Interior Using Synchrotron X-ray
Li Zhang

Abstract: Studying properties of minerals at high pressure and high temperature conditions corresponding to the Earth’s deep interior is crucial for understanding the structure and constitution of our planet. Diamond anvil cells coupled with synchrotron X-ray techniques have led to several key discoveries in the deep Earth. In this presentation, I will briefly introduce how scientists apply synchrotron x-ray to explore inaccessible interiors of the Earth and other planets. By analyzing the synchrotron x-ray diffraction data, for instance, we are able to construct how atoms are arranged in a submicron-sized mineral grain at megabar pressure corresponding to the Earth’s core mantle boundary.

Bio: Dr. Li Zhang is an associate staff scientist of HPSTAR and was awarded the “Youth 1000-Talent Plan” of China. Dr. Zhang formed the High-Pressure Mineral Physics Group in HPSTAR to study physical properties and crystal chemistry of minerals at extremely high temperature and pressure conditions corresponding to the Earth's deep interior, improving the understanding of the constitution of the earth's deep interior and providing interpretation of the properties of the Earth's deep interior detected by seismic waves. Li has been engaged in high pressure research for over 10 years in fields including but not limited to: high pressure mineral physics, high pressure crystallography, planet science and high pressure materials composition. Several articles written by her as the first author have been published by the prevailing academic Journals of earth science such as Science, PNAS, EPSL and GRL.

Neutron Scattering at High Pressure and Temperature: Insights into Structure and Dynamics
Simon Redfern

Abstract: Neutrons offer a complementary method for investigating materials at extremes of pressure and temperature, as well as other field variables such as electric or magnetic fields. The interaction of the neutron, dependent on scattering from the atomic nucleus as well as magnetic spin, means that data complementary to that of X-ray scattering (dominated by electron-scattering) may be obtained. Traditionally, neutrons have proven invaluable for elucidating magnetic structures in solids, as well as the positions of light elements in the presence of heavy atoms, where X-rays suffer from lack of sensitivity (for example, hydrogen positions in heavy-metal hydroxides, or in magnesium silicates). Neutrons also have great utility in probing the dynamic properties of solids, through inelastic and quasi-elastic scattering. The weak interaction of the neutron with matter has two consequences for extreme pressure/temperature studies. The negative consequence is that relatively large sample sizes are needed, which limits the pressures that may realistically be obtained, while the positive consequence is that neutrons can “see through” anvils and other apparatus used to generate extreme conditions. The development of high-P/T apparatus at neutron scattering laboratories will be reviewed, and some of the applications of this science will be discussed.

Bio: Prof. Simon Redfern is a professor of Mineral Physics at the Department of Earth Sciences, University of Cambridge, UK. Before coming to Cambridge, Simon was a Lecturer in Geochemical Spectroscopy in the Departments of Earth Sciences and Chemistry at the University of Manchester. He is the Chair of the NERC Cambridge Earth System Science DTP as well as being a Director of Studies at Jesus College.

Simon is currently a member of the NERC Science & Innovation Strategy Board, the Peer Review College, as well as serving as a member of Science Board at STFC. Recently, Simon served as a British Science Association Science Media Fellow at the BBC, experiencing the mechanisms by which scientific discovery and journalistic exposition interact, both in written and broadcast media. He is keen to help in efforts to make scientific methods and processes, as well as discoveries, accessible to a wide audience.

Strength and Elasticity of Materials under Pressure
Sean Shieh

Abstract: Plate tectonics and Earth-quake are commonly occurring on Earth, and are correlated to geological materials moving endlessly within the Earth. This fact reveals that the geological materials in certain conditions are subjected to various degree of deformation at high pressure and temperature conditions. Therefore, strength studies of materials at high pressure provide insightful information for mantle rheology and convection of the deep Earth. Besides, knowledge of elasticity of materials is important for understanding the seismic discontinuities and seismic anomalies within deep Earth. In this talk, the strength and elasticity of several Earth and planetary materials are reported and their geological implications are discussed.

Bio: Dr. Sean Shieh is an associate professor of mineral physics from Western University, Canada. Dr. Shieh's research interests are: Mineral physics; high-pressure and high-temperature experiment using a diamond anvil cell; Material study under extreme P-T conditions; Structures and dynamics of the Earth's and planetary interiors; Characterization of materials (e.g. equation of state, phase transition, elasticity, strength, rheology) using synchrotron X-ray and Raman spectroscopy; Exploration of novel and super-hard materials; Material-fluid interaction.

X-ray Scanning Micro/Nanoprobe and Application in Materials Science
Zhonghou Cai

Abstract: The distinct nature for X-rays to interact with matter has made X-ray microscopy a great complement to many other microscopy techniques. Utilizing synchrotron radiation of high brilliance and advanced focusing optics, scanning probe based X-ray microscopy has pushed its spatial resolution to a level (30-400 nm with an energy range of 5-30 keV) that covers fundamental length scales in structure and dynamics of various material systems. It combines X-ray micro/nano focusing capability with x-ray's high sensitivity in chemical element and crystallographic structure to study spatially resolved elemental content, microstructure, crystallographic phase, lattice strain, and collective electronic state. In this talk I will present the development of the X-ray microscopy techniques at the Advanced Photon Source and their applications in device and device materials, material engineering, and condensed matter physics.

Bio: Dr. Zhonghou Cai is a physicist in X-ray Scuebce Division, Advanced Photon Source, ANL, US. His research interests are: X-ray microdiffraction and microspectroscopy imaging of crystallographic phase, chemical and phase composition, and microstructure; Structure and property relations of materials particularly in areas of corrosion resistance and energy efficiency; Applications of microdiffraction and microfluorescence techniques in device materials, microelectronic devices, materials under extremely high pressure, condensed matter

physics, electrochemistry, and individual nanoscale materials; Development of X-ray microscopy instrumentation.

Unveiling High-Pressure Chemistry
Kuo Li

Abstract: The chemical reaction of materials at high pressure is one of the most attractive topics of high pressure science. How do the five traditional chemical sciences (inorganic chemistry, organic chemistry, analytical chemistry, physical chemistry and high polymer chemistry) get changed to conform to high pressure science? What exploratory research on high pressure science have been done in the field of chemistry? This report will introduce high-pressure chemistry to you.

Bio: Dr. Kuo Li joined Prof. Jianhua Li's Research Group of Inorganic Chemistry Institute of Chemistry and Molecular Engineering College of Peking University to study solid chemistry and crystallography in 2006. In 2011, he participated in Geophysics Lab of Carnegie Research Institute of US to do postdoctoral research after obtaining the doctorate. He undertook the research on high pressure synchrotron radiation and high pressure neutron scattering at several places such as ANL APS (Argonne National Laboratory Advanced Photon Source) and ORNL SNS (Oak Ridge National Laboratory Spallation Neutron Source) and made a broad cooperation with the neutron scientists at home and abroad. At present, he is an associate researcher of HPSTAR (Beijing) to form the High-Pressure Chemistry Research group. His major research interests are: studying unique high-pressure chemical reaction with crystallographic methods (such as neutron diffraction) as well as the methods of spectroscopy, electricity and chemical analysis; compounding new materials with the method of high pressure.

High-Pressure Crystallization
Andrzej Katrusiak

Abstract: Various crystallization techniques are used for versatile applications in scientific research and technology. Most of them are isobaric crystallizations performed by lowering temperature of the melt, evaporation of the solution, sublimation, gel method, and solubility by diffusion, all at atmospheric (0.1 MPa) or nearly atmospheric pressure. High pressure offers new means of crystallization, mainly associated with isothermal and isochoric methods. New materials can be obtained in this way - not only super hard materials, but also new phases of the well-known compounds as well as the crystals of new compositions (solvates). Such transformations can be useful for pharmaceutical and agricultural applications: the isobaric crystallization yields neat compounds of the substances that can be easily solvated at high pressure. This applies equally to molecular and ionic crystals of organic and inorganic compounds. For example, ionic 1,4-diazabicyclo [2.2.2] octane hydroiodide (dabcoHI) crystallizes exclusively as the neat compound at 0.1 MPa, but it forms two polymorphs of monohydrate (dabcoHI·H_2O) above 0.5 and 0.7 GPa, while above 1.0 GPa the unsolvated dabcoHI is formed again, albeit in another polymorphic form. Thiourea, $C1(NH_2)_2S$, behaves in an analogous way.

Bio: Prof. Andrzej Katrusiak is the head of Department of Materials Chemistry in Adam Mickiewicz University in Poznań, Poland. His research interests are materials chemistry, thermodynamics, phase transitions, extreme conditions, crystallography, single-crystal and powder diffractometry, materials analysis; high-pressure equipment, and programming.

Note:

Center for High Pressure Science & Technology Advanced Research
1690 Cailun Rd, Bldg #6, Pudong, Shanghai, 201203, P.R. China
Tel: +86 (021) 8017-7000
Fax: +86 (021) 8017-7064
http://www.hpstar.ac.cn