COMPRES Individual Annual Report

Name: Xinguo Hong, Ph.D.

Position: Research scientist, Mineral Physics Institute, Stony Brook University;
Served as beamline scientist, XPD-D beamlines, NSLS-II.
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Length of current position: 2010—present

Brief job description

As beamline scientist of X17DAC beamlines (B3 and C), I have conducted the intensive users support, beamline operation, maintenance and upgrading. I have done my best to complete all the important projects of X17DAC facility these years. Despite of lacking important on-site supporting, I have successfully overcome numerous tough problems and difficulties. We have developed a new method of X-ray energy calibration, high energy X-ray focusing, laser heating and high-pressure PDF techniques, etc. I have pushed X17DAC sciences significantly forward.

I have been playing a leadership in the developments of 1) high-pressure PDF measurement (Hong et al, APL 2014; SRI2015 talk; paper in press; JPCM, paper accepted/in press, 2015); 2) high energy X-ray focusing (ICXOM23 talk; Hong et al, submitted to Nature Sci Rep); 3) high precision X-ray energy calibration (Hong et al, RSI 2012; SRI2015, in press); 4) establish an in-situ laser heating system; 5) HP-XAFS (Hong et al, JPCM 2014).

After Zhiqiang Chen's leaving, I had supported all users of X17C and X17B3 beamlines. At X17DAC facility, I work extremely hard, and the research is pretty productive. I have carried out the major decommissioning work of X17DAC beamlines and the supporting labs.

Research activities (2014—2015)

Outline

I) Intensive users supporting in 2014
II) Tremendous decommissioning work of X17DAC beamlines, NSLS
III) Preliminary installation of DAC at XPD-D, NSLS-II

IV) Research highlights and achievements

1. **Progress of the absolute x-ray energy calibration method**
2. **High-pressure pair distribution function (HP-PDF)**
3. **High-energy X-ray focusing**
4. **Pressure-induced stiffness of Au nanoparticles**
5. **High-pressure XAFS**
6. **Recent progress of laser heating project**

V) Academy activities and talks at international SR conferences
VI) My publications (2014—2015)

I) Intensive users supporting in 2014

There were many users coming to X17DAC for high pressure DAC experiments. Let's take one short example. Here is the list of X17DAC proposals (last cycle of NSLS), which I supported alone.

X17C:

Last cycle of NSLS facility

Form #	PI Name	Institution	Tittle
20005	Maining Ma	University of Chinese Academy of Sciences	Study on Equation of State of Natural Garnets
21973	Chunli Ma	Jilin University	High pressure X-ray diffraction studies of cyclopentane
22487	Yongzhou Sun	Florida International University	Interaction of Lithium amidoborane and nanoconfined hydrogen at high pressureammonia borane with
23528	Dawei Fan	Institute of Geochemistry@CAS	Effect of hydration on the elastic properties of pyrope at high pressures
24066	Hongyang Zhu	Jilin University	High Pressure Synchrotron X-ray diffraction studies on Ammonium Azide
25091	Xiaoxiang Xi	Brookhaven National Laboratory	Pressure-induced topological phase transitions in PbSe, PbTe, and Sb2Se3 studied by X-ray powder diffraction
25109	Davide Levy	University of Tel Aviv	behaviour of two precursors of energetic materials at High Pressure: HBIW and HAIW
25134	Jinggeng Zhao	Harbin Institute of Technology	Study of structure evolutions of topological insulator under high pressure
25178	Lingping Kong	HPSTAR	The Compressibility, Surface Energy, and Phase Stability of Nano-Titania
25182	Zhenhai Yu	HPSTAR	In situ high pressure AD-XRD study of the structural evolution behavior of 3d transition metal pnictides
25218	Gang Liu	HPSTAR	High Pressure XRD and IR Study of Polytypically Disordered Nano-ZnS
26329	Zhishuang Xu	Graduate University of the Chinese Academy of Sciences	Study on elasticity of hydrous pyroxene at high pressure and high temperature

26492	Bin Chen	HPStar: Center for High Pressure Science and Techn	Copy of High Pressure IR and XRD Study of Mix-stacking Nano-ZnS
26546	Yanzhang Ma	Texas Technical University	High pressure and shear induced phase transition in group III nitride
27016	Chunyu Li	HPStar: Center for High Pressure Science and Techn	The structural evolution behavior of Bismuth Selenide under nonhydrostatic conditions up to Mbar pressures
27057	Davide Levy	University of Tel Aviv	Energetic materials at High Pressure: 5-aminoterazole and 5-aminoterazolium nitrate
27113	Qinghua Wu	SUNY @ Stony Brook	Phase stabilities of pure Ti2C and Ti3C2 compounds under high pressures
27283	Zhongying Mi	HPStar: Center for High Pressure Science and Techn	Water Effect on the Compressibility, Slip and Texture Information of Olivine to Mantle Pressures
27306	Melissa Sims	SUNY @ Stony Brook	Detection of Structural Changes in Epidote at High Pressure and Temperature using Powder Diffraction
27376	Itzhak Halevy	Nuclear Research Center Negev, NRCN	The Fe-Cr-H system, crystallographic and magnetic phase diagram under high-Pressure
27392	Itzhak Halevy	Nuclear Research Center Negev, NRCN	The Lu2Co17-H and Lu2Ni17-H systems, crystallographic and magnetic phase diagram under high-Pressure
27397	Trevor Tyson	New Jersey Institute of Technology	Exploring Electric Polarization Mechanisms in Multiferroic Oxides: High Pressure Structures

X17B3:

Last cycle of NSLS facility

Form #	PI Name	Institution	Tittle
22005	Bingbing Liu	Jilin University	High pressure PDF study of polymorphism in TiO2 nanomaterials
25188	Lars Ehm	SUNY @ Stony Brook	Pressure-induced phase transition mechanisms in relaxor ferroelectrics
26309	Gang Liu	HPStar: Center for High Pressure Science and Techn	Size effect of interface embrittlement in nano Ni-S system under high pressure
27139	Xiang Zhu	Zhengzhou University of Light Industry	In Situ Synchrotron X-Ray Diffraction and Infrared Spectroscopic Study of Ionic Liquid under High Pressure
27175	Sean Shieh	Western University	Deformation and Strength of Zircon at High Pressure and High Temperature
27258	Xinguo Hong	SUNY @ Stony Brook	High resolution radial X-ray diffraction using high-energy X-ray microbeam
27338	Sean Shieh	Western University	Stability and elasticity of Chromium Spinels

27404	Trevor Tyson	New Jersey Institute of Technology	Ferroelectricity in SrTiO3 nanoparticles: High Resolution X-Ray Diffraction

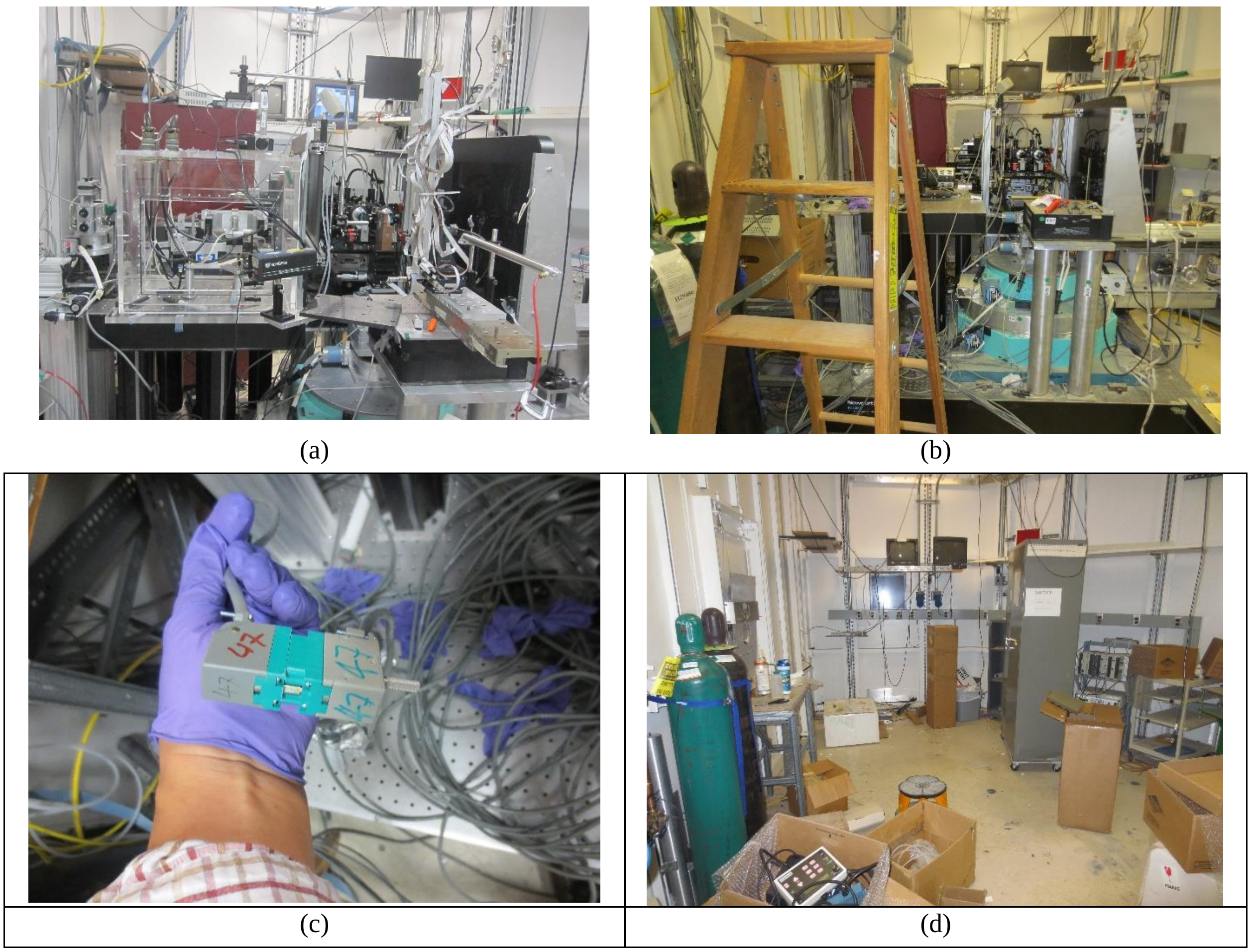
Here is **some publications of X17DAC in 2015** (many others are coming):

1. Y. Zou, X. Wang, T. Chen, X. Li, X. Qi, D. Welch, P. Zhu, B. Liu, T. Cui and B. Li, Scientific Reports 5, 10811 (2015).
2. B. Zhou, G. Xiao, X. Yang, Q. Li, K. Wang and Y. Wang, Nanoscale 7 (19), 8835-8842 (2015).
3. R. Zhao, P. Wang, B.-b. Yao, T.-t. Hu, T.-y. Yang, B.-x. Xiao, S.-m. Wang, C.-h. Xiao and M.-z. Zhang, RSC Advances 5 (23), 17582-17587 (2015).
4. H. Zhang, T. Yu, Z. Chen, C. S. Nelson, L. N. Bezmaternykh, A. M. M. Abeykoon and T. A. Tyson, Physical Review B 92 (10), 104108 (2015).
5. F. X. Zhang, M. Lang and R. C. Ewing, Applied Physics Letters 106 (19), 191902 (2015).
6. Z. Xiong, X. Liu, S. Shieh, F. Wang, X. Wu, X. Hong and Y. Shi, Phys Chem Minerals 42 (3), 171-177 (2015).
7. G. Xiao, X. Yang, X. Zhang, K. Wang, X. Huang, Z. Ding, Y. Ma, G. Zou and B. Zou, Journal of the American Chemical Society 137 (32), 10297-10303 (2015).
8. C. L. Tracy, Doctor of Philosophy, the University of Michigan, 2015.
9. P. Serra-Crespo, A. Dikhtiarenko, E. Stavitski, J. Juan-Alcaniz, F. Kapteijn, F.-X. Coudert and J. Gascon, CrystEngComm 17 (2), 276-280 (2015).
10. W. R. Panero, J. S. Pigott, D. M. Reaman, J. E. Kabbes and Z. Liu, Journal of Geophysical Research: Solid Earth 120 (2), 894-908 (2015).
11. I. Morozova, Master of Science, The University of Western Ontario, 2015.
12. Q. Li, R. Liu, T. Wang, K. Xu, Q. Dong, B. Liu, J. Liu and B. Liu, AIP Advances 5 (9), 097128 (2015).
13. H. Li, Y. Li, N. Li, Y. Zhao, H. Zhu, P. Zhu and X. Wang, RSC Advances 5 (55), 44121-44127 (2015).
14. N. M. T. B. Khan, Master of Science, The University of Western Ontario, 2015.
15. Jinlong Zhu, L. Yang, H.-W. Wang, J. Zhang, W. Yang, Xingguo Hong, C. Jin and Y. Zhao, submitted (2015).
16. S. J. Jaret, W. R. Woerner, B. L. Phillips, L. Ehm, H. Nekvasil, S. P. Wright and T. D. Glotch, Journal of Geophysical Research: Planets 120 (3), 570-587 (2015).
17. X. Hong and X. Hong, AIP Conference Proceedings (12th International Conference on Synchrotron Radiation Instrumentation) accepted/in press (2015).
18. X. Hong, L. Ehm, Z. Zhong, S. Ghose, T. S. Duffy and D. J. Weidner, submitted (2015).
19. X. Hong, L. Ehm, Z. Zhong, S. Ghose, T. S. Duffy and D. J. Weidner, AIP Conference Proceedings (23rd International Congress on X-ray Optics and Microanalysis) Submitted (2015).
20. X. Hong, L. Ehm, Z. Zhong, S. Ghose, T. S. Duffy and D. J. Weidner, AIP Conference Proceedings (12th International Conference on Synchrotron Radiation Instrumentation) accepted/in press (2015).
21. X. Hong, T. S. Duffy, L. Ehm and D. J. Weidner, submitted (2015).
22. X. Hong, T. S. Duffy, L. Ehm and D. J. Weidner, AIP Conference Proceedings (12th International Conference on Synchrotron Radiation Instrumentation) accepted/in press (2015).

23. V. Drozd, A. Durygin, S. Saxena, V. E. Antonov and M. Tkacz, Journal of Alloys and Compounds 619, 78-81 (2015).
24. S. M. Dorfman, S. R. Shieh and T. S. Duffy, Journal of Applied Physics 117 (6), 065901 (2015).

II) Tremendous decommissioning work of X17DAC beamlines (till BNL deadline 4/15/2015)

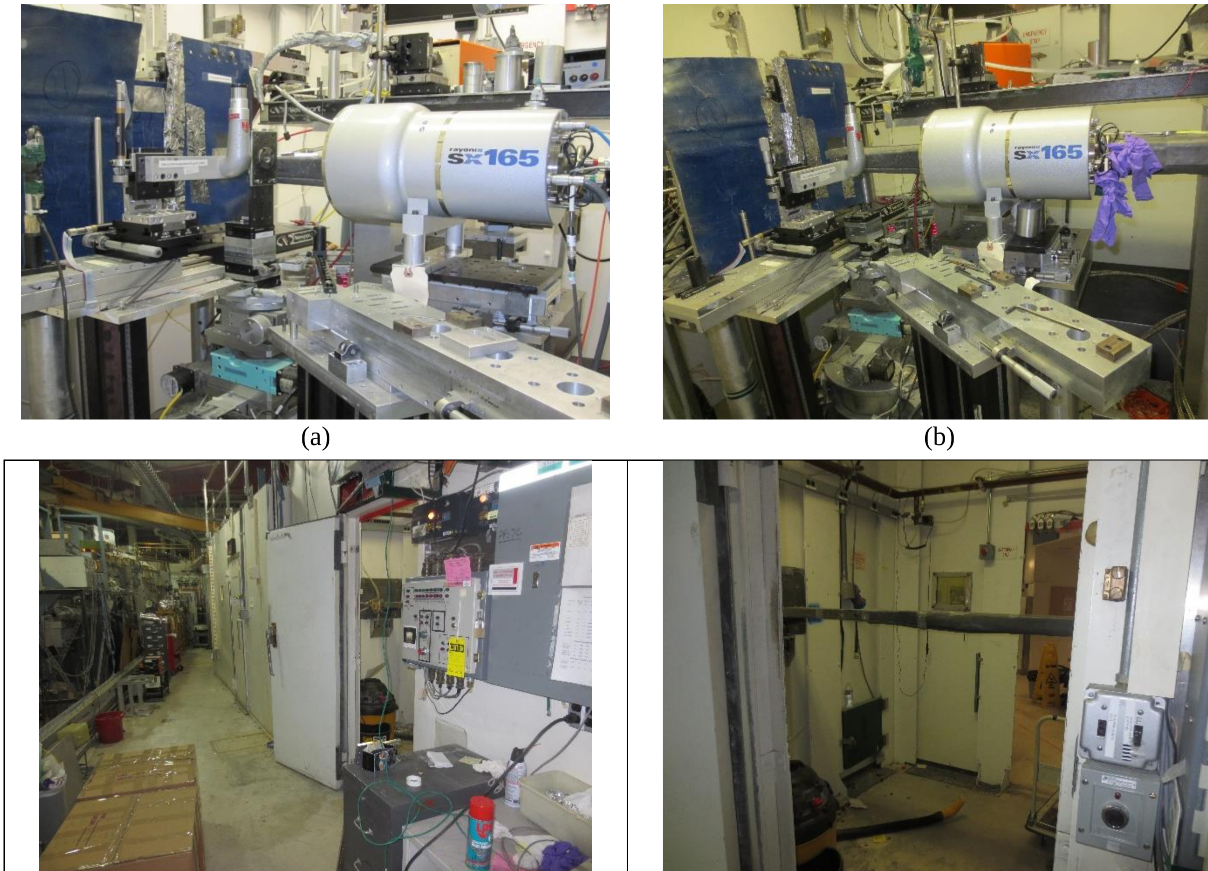
Decommissioning of X17B3 beamline:



(a) (b) (c) (d)

FIGURE 1. X17B3 decommissioning. (a) DAC experiment; (b) beamline disassembly; (c) electronic work; (d) empty B3 hutch.

Decommissioning of X17C beamline:



(a) (b)

(c) (d)

FIGURE 2. X17C decommissioning. (a) DAC experiment; (b) beamline disassembly; (c) empty hutch outside; (d) empty C hutch.

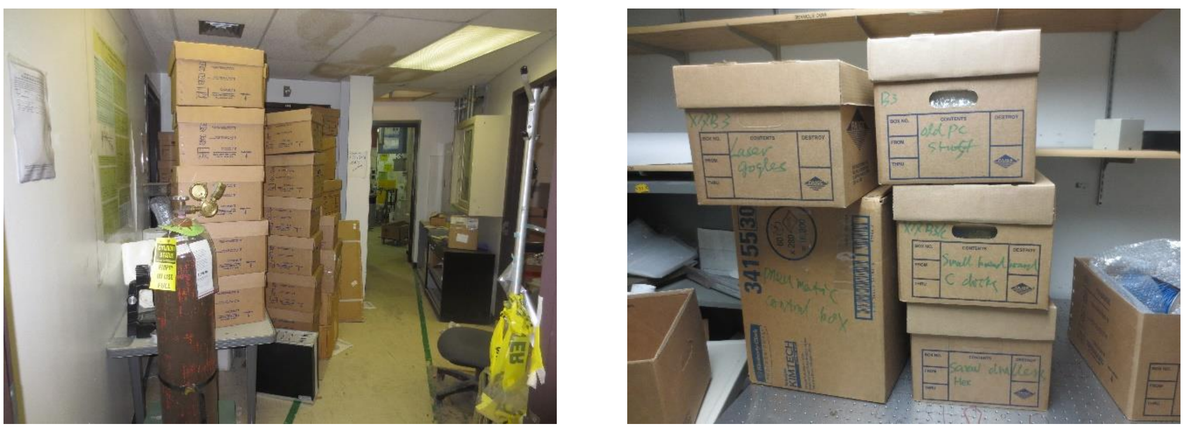
Decommissioning of X17 supporting Lab:

(a) (b)

(c)	(d)

FIGURE 3. X17DAC supporting lab decommissioning. (a) Ruby system in use; (b) sample preparation lab; (c) Packing Ruby laser; (d) the empty supporting lab.

Packing and moving all boxes to MPI, SBU:

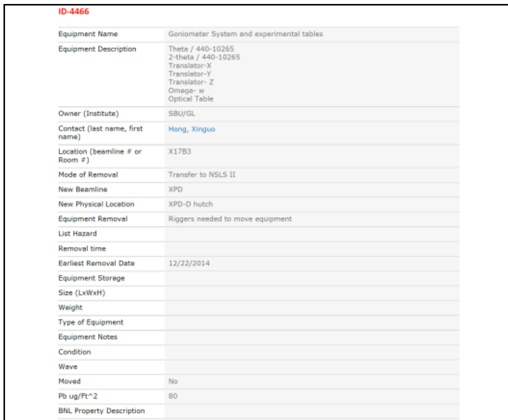


(a) (b)

(c)	(d)

FIGURE 4. Packing all items of X17DAC beamlines (a-d) examples of packed boxes.

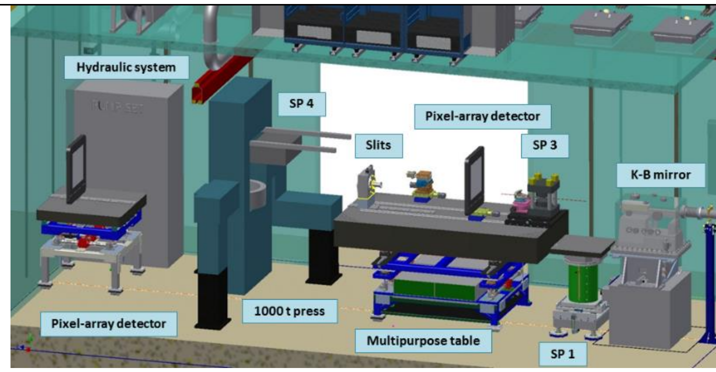
III) Preliminary installation of DAC at XPD-D



ID-4466

Equipment Name	Goniometer System and experimental tables
Equipment Description	Theta / 440-10265 2-theta / 440-10265 Translator-X Translator-Y Translator- Z Omega- w Optical Table
Owner (Institute)	SBU/GL
Contact (last name, first name)	Hong, Xinguo
Location (beamline # or Room #)	X17B3
Mode of Removal	Transfer to NSLS II
New Beamline	XPD
New Physical Location	XPD-D hutch
Equipment Removal	Riggers needed to move equipment
List Hazard	
Removal time	
Earliest Removal Date	12/22/2014
Equipment Storage	
Size (LxWxH)	
Weight	
Type of Equipment	
Equipment Notes	
Condition	
Wave	
Moved	No
Pb ug/Ft^2	80
BNL Property Description	

(a)



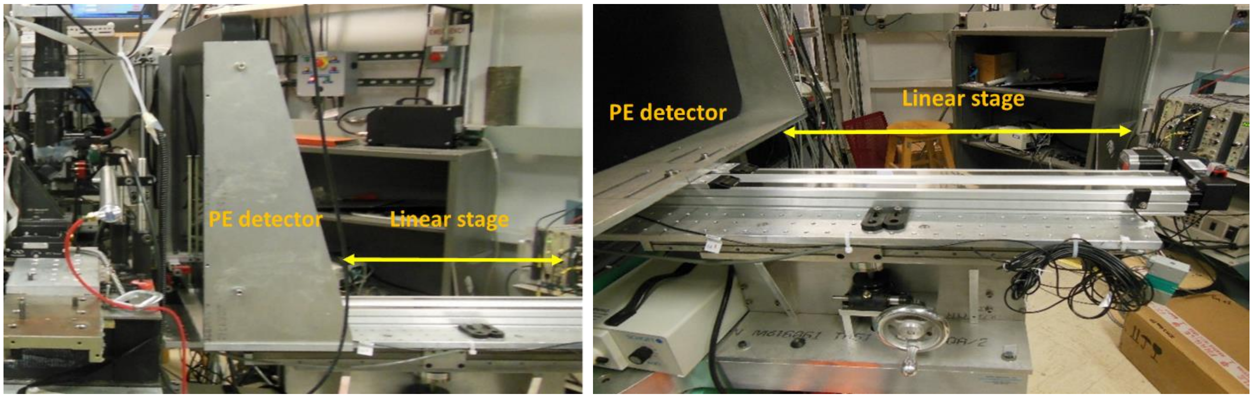
(b)

FIGURE 5. Installation of DAC at XPD-D (a) example of the paperwork and Pb examination on all items moved to NSLS-II; (b) DAC/LVP layout at XPD-D.

IV) Research highlights and achievements (2014-present)

1. Recent progress of our absolute x-ray energy calibration (Hong et al., RSI 2012; SRI 2015)

Accurate X-ray energy calibration is indispensable for X-ray energy-sensitive scattering and diffraction experiments using synchrotron radiation. The absence of well-defined features such as characteristic lines in synchrotron radiation requires frequent in-situ energy calibration with good precision so as to identify and correct unpredictable energy drifts[1]. Nevertheless, calibrating the high energy X-ray beam or monitoring its subtle energy drifting over a course of experiment for a few days is a challenge because there may be no appropriate absorption edge available for conducting a traditional X-ray absorption-based calibration. Recently, we have developed a diffraction-based iterative method to precisely calibrate X-ray energy over a wide range by using high precision gauge blocks [2]. This method doesn't rely on any edge of specific elements and is especially useful when normal transmission monitoring for scanning X-ray energy is not an option and complicated micro-focusing optics are fixed in place. Recently
We have made some developments of this diffraction-based method by using a motorized long translation stage to achieve the required high spatial resolution for X-ray energy calibration method.



(a) (b)

FIGURE 6. Picture of the absolute X-ray energy calibration using a motorization stage: (a) PE detector; (b) motorization stage.

2. Developing high-pressure pair distribution function (HP-PDF) techniques (Hong et al., APL 2014; SRI 2015, in press)

It is proven that the atomic pair distribution function (PDF) method obtained using high-energy X-ray or neutron diffraction is a powerful tool for studying crystalline, disordered and nano materials [3-5]. The total scattering, including Bragg peaks as well as diffuse scattering, contributes to the PDF, and is particularly useful for characterizing aperiodic distortions in crystals [4]. Because of the potentially important role of liquids and disordered solids in the Earth's interior, it is of interest to use the PDF method to characterize the structural variation at short, intermediate and long range order under extreme conditions of high pressure and temperature [6, 7]. Recent years, we have intensively developed /improved X-ray total scattering pair distribution function (PDF) technique using high energy X-ray. This is an emerging structural analysis method in high pressure research. In combination with the HP-XAFS technique [8 9], we have studied the geological important materials like GeO_2 glass in detail, see below.

Polyhedral units and network connectivity in GeO_2 glass at high pressure: An X-ray total scattering investigation

The authors report a pressure-induced dense tetrahedral intermediate state via Ge–O–Ge rotation formed at 3–5 GPa and the polyhedral relations in GeO_2 glass up to 17.5 GPa using in situ X-ray total scattering and X-ray absorption (XAFS) techniques. It was found that the nearest-neighbor Ge–Ge correlations show a decrease reaching a minimum between 4 and 6 GPa, and exhibit negative compression behavior at 7–17.5 GPa. The Ge–Ge distance determined by XAFS shows a substantial reduction, i.e., normal compression behavior, at 7–17.5 GPa. The comparison with the theoretical g(r) function for rutile-type GeO_2 (16.1GPa) indicates that the negative compression of intermediate range order reflects the direct formation of GeO_6 octahedral units. Results of coordination number analysis show that GeO_2 glass undergoes a transition from tetrahedral GeO_4, to GeO_5 units (possibly triangular bipyramidal), and finally to octahedral GeO_6 units. The present investigation provides the structural details of the polyhedral units and their relationships in GeO_2 glass at high pressure.

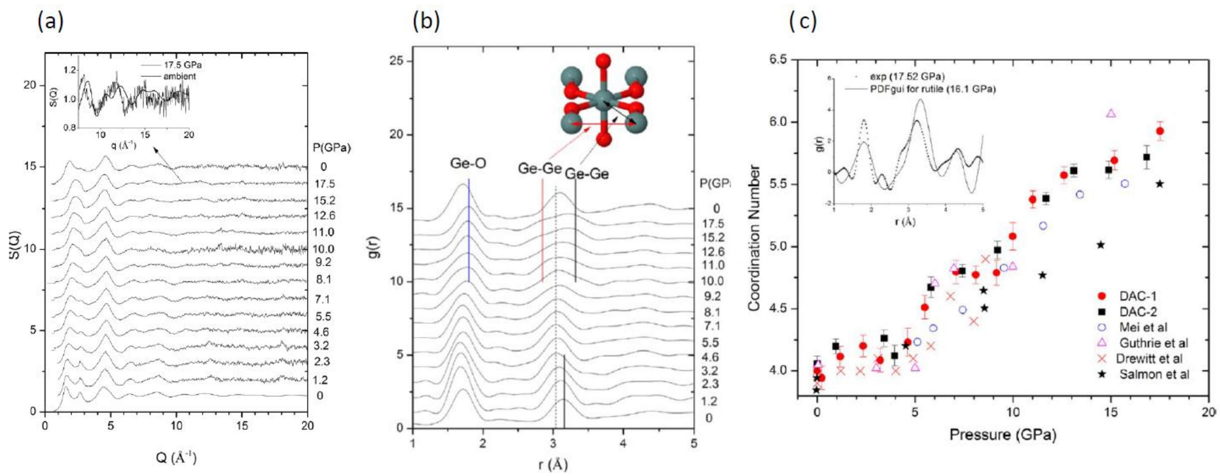


FIGURE 7. (a) Structure factor, S(Q), for GeO_2 glass at different pressures; (b) Pair distribution function g(r) for GeO_2 glass; (c) The pressure evolution of the mean coordination number N_{Ge}^{O} for GeO_2 glass

Reference: Hong X, Ehm L and Duffy T S 2014 Polyhedral units and network connectivity in GeO_2 glass at high pressure: An X-ray total scattering investigation, Applied Physics Letters 105 081904

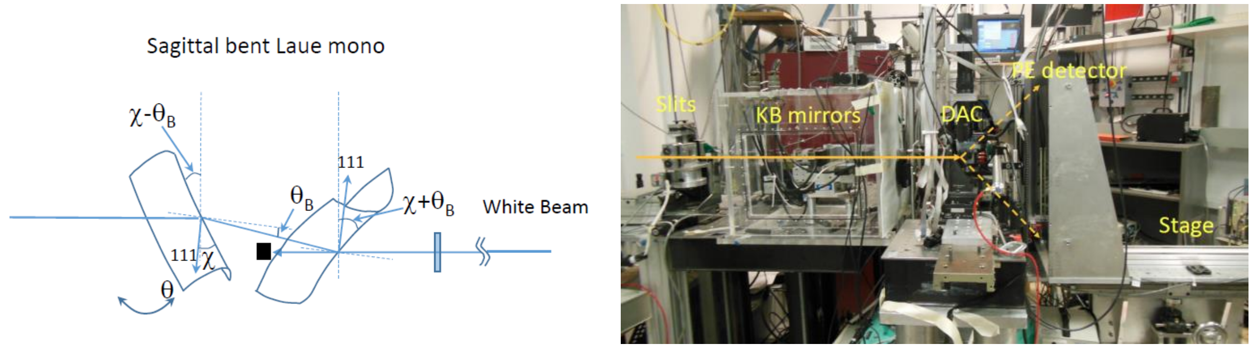
3. **Pressure-induced stiffness of Au nanoparticles (Hong et al., JPCM accepted, 2015)**

In this JPCM paper, we reported the HP-PDF investigation of the compressibility of nanocrystalline gold (n-Au, 20 nm) by X-ray total scattering using high-energy monochromatic X-rays in the diamond anvil cell (DAC) under quasi-hydrostatic conditions up to 71 GPa. The bulk modulus, K0, of the n-Au obtained from fitting to a Vinet equation of state is ~196(3) GPa, which is about 17% higher than for the corresponding bulk materials (K0: 167 GPa). At low pressures (<7 GPa), the compression behavior of n-Au shows little difference from that of bulk Au. With increasing pressure, the compressive behavior of n-Au gradually deviates from the equation of state (EOS) of bulk gold. Analysis of the pair distribution function (PDF), peak broadening and Rietveld refinement reveals that the microstructure of n-Au is nearly a single-grain/domain at ambient conditions, but undergoes substantial pressure-induced reduction in grain size until 10 GPa. The results indicate that the nature of the internal microstructure in n-Au is associated with the observed EOS difference from bulk Au at high pressure. Full-pattern analysis confirms that significant changes in grain size, stacking faults, grain orientation and texture occur in n-Au at high pressure. We have observed direct experimental evidence of a transition in compressional mechanism for n-Au at ~20 GPa, i.e., fromdeformation dominated by nucleation and motion of lattice dislocations (dislocation-mediated) to a prominent grain boundary mediated response to external pressure. The internal microstructure inside the nanoparticle (nanocrystallinity) plays a critical role for the macro-mechanical properties of nano-Au.

Reference: Xinguo Hong, Thomas S. Duffy, Lars Ehm, and Donald J. Weidner, "Pressure-induced stiffness of Au nanoparticles to 71 GPa under quasi-hydrostatic loading", Journal of Physics: Condensed Matter, accepted (in press) (2015).

4. **High-energy X-ray focusing technique (SRI 2015 talk; IXCOM23 talk; Hong et al., submitted)**

Acquiring the pair distribution function (PDF) using a large unfocused X-ray beam for high-pressure diamond anvil cell (DAC) experiments results in low signal intensity and long data acquiring time, with the data potentially adversely affected by parasitic scattering from upstream beamline slits and background contribution due to diamonds and gasket materials. As a result, PDF analysis is at present generally limited to pressures of <10 GPa. These years, we have developed a combined high-energy X-ray focusing technique, which is well suited to the PDF experiments under extreme conditions using a diamond anvil cell.



(a) (b)

FIGURE 8. (a) Schematic layout of the high-energy X-ray focusing optics by the sagittally bent Laue crystals; (b) K–B mirrors focusing setup at X17B3 station.

5. High-pressure XAFS technique for geosciences

While X-ray diffraction has been playing a dominant role in the high pressure research, the powerful XAFS tool for probing local structure is largely remained under development. We have recently described an approach for acquiring high quality x-ray absorption fine structure (XAFS) spectroscopy spectra with wide energy range at high pressure using diamond anvil cell (Hong et al., RSI 2009; JPCM 2014).

The structural behavior of GeO_2 glass has been investigated up to 64 GPa using results from x-ray absorption spectroscopy in a diamond anvil cell combined with previously reported density measurements. The difference between the nearest Ge–O distances of glassy and rutile-type GeO_2 disappears at the Ge–O distance maximum at 20 GPa, indicating completion of the tetrahedral–octahedral transition in GeO_2 glass. The mean-square displacement σ^2 of the Ge–O distance in the first Ge–O shell increases progressively to a maximum at 10 GPa, followed by a substantial reduction at higher pressures. The octahedral glass is, as expected, less dense and has a higher compressibility than the corresponding crystalline phase, but the differences in Ge–O distance and density between the glass and the crystals are gradually eliminated over the 20–40 GPa pressure range. Above 40 GPa, GeO_2 forms a dense octahedral glass with a compressibility similar to that of the corresponding crystalline phase (α-PbO_2 type). The EXAFS and XANES spectra show evidence for subtle changes in the dense glass continuing to occur at these high pressures. The Ge–O bond distance shows little change between 45–64 GPa, and this may reflect a balance between bond shortening and a gradual coordination number increase with compression. The density of the glass is similar to that of the α–PbO2-type phase, but the Ge–O distance is longer and is close to that in the higher-coordination pyrite-type phase which is stable above ~60 GPa. The density data provide evidence for a possible discontinuity and change in compressibility at 40–45 GPa, but there are no major changes in the corresponding EXAFS spectra. A pyrite-type local structural model for the glass can provide a reasonable fitting to the XAFS spectra at 64 GPa.

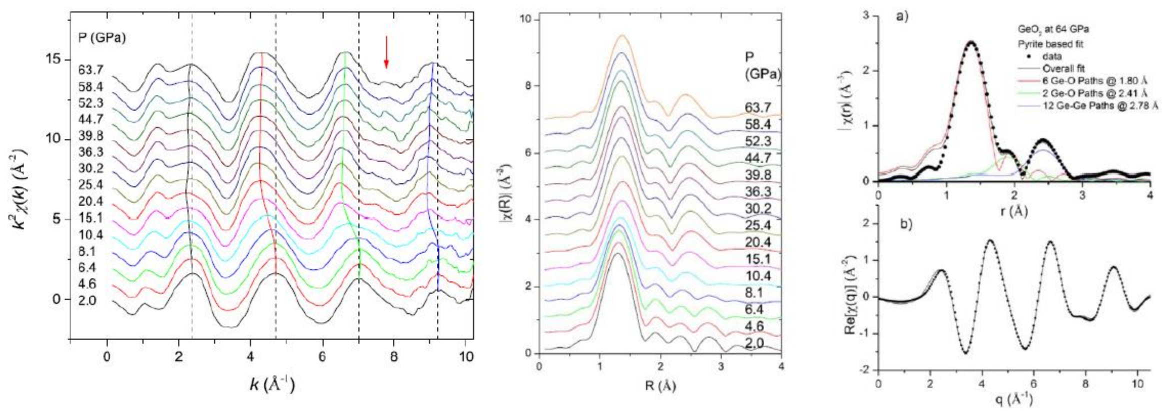
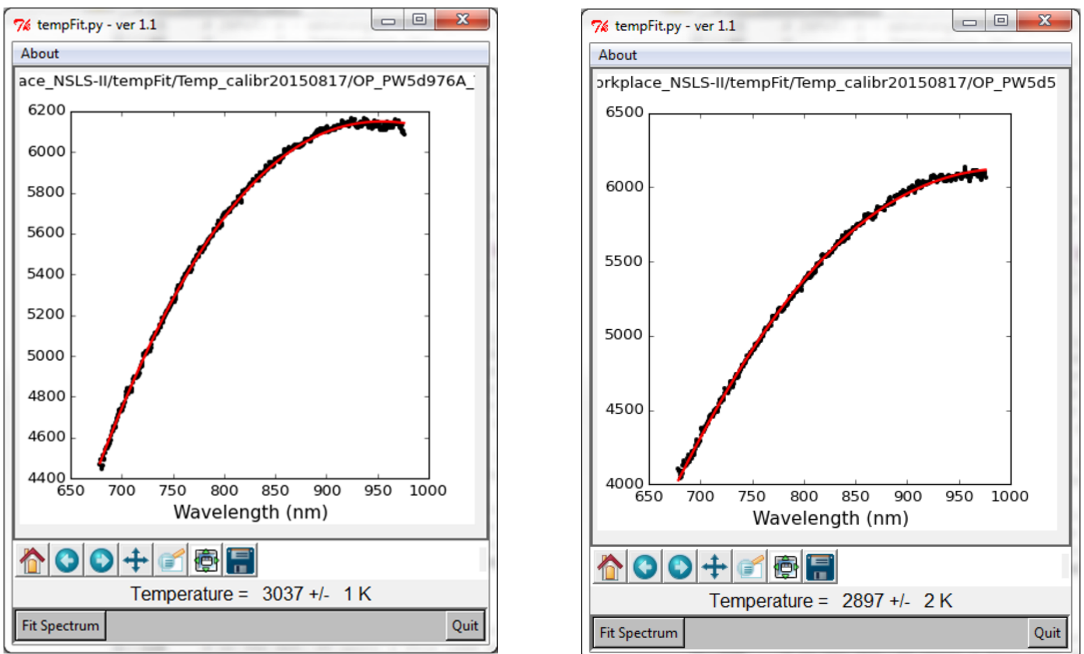


FIGURE 9. Left panel: k^2-weighted XAFS spectra, $k^2\chi(k)$, for GeO_2 glass at high pressures. Middle panel: XAFS Fourier transform, $|\chi(R)|$, for GeO_2 glass at high pressures. Note the merging of two peaks (2.2—3Å) at 10.4 GPa. Right panel: The pyrite-based structural modelling for GeO_2 glass at 63.7 GPa (full circles).

Reference: Hong X, Newville M, Duffy T, Sutton S and Rivers M, "X-Ray Absorption Spectroscopy of GeO_2 Glass to 64 GPa." Journal of Physics: Condensed Matter 26, no. 3 (2014): 035104.

6. Recent progress of laser heating project

These years, we have spent a lot of efforts to establish the laser heating capability at X17B3 station whenever we have no beamtime. The motorization and optics were well done. The system is easy to use and has been used for several DAC heating experiments. However, due to the critical budget reduction of X17DAC, unfortunately we can't meet the lowest requirement of NSLS, i.e. two persons to operate the LH system. In early 2013, COMPRES decided to keep only one staff at two X17DAC beamlines (C and B3). The last remained thing for this laser heating system was the temperature measurement. After NSLS decommissioning, I have spent time and solved the problem of temperature measurement with the help from some users. Here is the images for temperature measurement.



(a) (b)

FIGURE 10. (a) Python based software for LH temperature measurement (thanks to J. Townsend and Z. Liu)

References:

1. J. O. Cross and A. I. Frenkel, Review of Scientific Instruments **70** (1), 38-40 (1999).
2. X. Hong, Z. Chen and T. S. Duffy, Review of Scientific Instruments **83** (6), 063901 (2012).
3. T. Egami and S. J. L. Billinge, Pergamon, Oxford (1994).
4. S. J. L. Billinge and M. G. Kanatzidis, Chemical Communications (7), 749-760 (2004).
5. C. D. Martin, S. M. Antao, P. J. Chupas, P. L. Lee, S. D. Shastri and J. B. Parise, Applied Physics Letters **86** (6), 061910 (2005).
6. C. D. Martin, S. M. Antao, P. J. Chupas, P. L. Lee, S. D. Shastri and J. B. Parise, Applied Physics Letters **86** (6), - (2005).

7. X. Hong, L. Ehm and T. S. Duffy, Applied Physics Letters **105** (8), 081904 (2014).
8. X. Hong, M. Newville, V. B. Prakapenka, M. L. Rivers and S. R. Sutton, Review of Scientific Instruments **80** (7), 073908-073910 (2009).
9. X. Hong, M. Newville, T. S. Duffy, S. R. Sutton and M. L. Rivers, Journal of Physics: Condensed Matter **26** (3), 035104 (2014).

V) Academy activities and talks at international SR conferences

- Oral talk on high-pressure PDF using high-energy X-ray focusing beam at *The 12th International Conference on Synchrotron Radiation Instrumentation*, July 6-10, 2015, NYC, USA. Papers by Hong et al have been accepted by AIP Conference Proceedings, in press (2015). See,
  https://www.bnl.gov/sri2015/
- Oral talk on high-energy X-ray focusing at *The 23rd International Congress on X-ray Optics and Microanalysis (ICXOM23)*, September 14-18, 2015, Upton, NY, USA. Paper by Hong et al have been submitted. See,
  https://www.bnl.gov/icxom23/
- Poster on X17DAC at 2015 NSLS-II/CFN users meeting.

VI) My publications (2014—present)

After all, I have made decent publications in the past year, see:

2014—present:

1. X. Hong, M. Newville, T. S. Duffy, S. R. Sutton and M. L. Rivers, Journal of Physics: Condensed Matter 26 (3), 035104 (2014).
2. X. Hong, L. Ehm and T. S. Duffy, Applied Physics Letters 105 (8), 081904 (2014).
3. X. Hong, T. S. Duffy, L. Ehm and D. J. Weidner, Journal of Physics: Condensed Matter, accepted (in press) (2015).
4. X. Xi, X.-G. He, F. Guan, Z. Liu, R. D. Zhong, J. A. Schneeloch, T. S. Liu, G. D. Gu, X. Du, Z. Chen, X. G. Hong, W. Ku and G. L. Carr, Physical Review Letters 113 (9), 096401 (2014).
5. T. Yu, T. A. Tyson, P. Gao, T. Wu, X. Hong, S. Ghose and Y. S. Chen, Physical Review B 90 (17), 174106 (2014).
6. J. Zhu, L. Yang, H. Wang, J. Zhang, W. Yang, X. Hong, C. Jin and Y. Zhao, Nature Scientific Report (minor revision) (2015).
7. Z. Xiong, X. Liu, S. R. Shieh, S. Wang, L. Chang, J. Tang, X. Hong, Z. Zhang and H. Wang, American Mineralogist (accepted, in press) (2015).
8. Z. Xiong, X. Liu, S. Shieh, F. Wang, X. Wu, X. Hong and Y. Shi, Phys Chem Minerals 42 (3), 171-177 (2015).

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