Beamline Scientist Individual Annual Report (Nov. 2016 – Nov. 2017)

**Name:** Jinyuan Yan

**Position:** Project Scientist

**Length of time at current position**: Since Feb. 2006

**Brief job description**: Provide user support, instrumentation development/improvement at beamline 12.2.2 , ALS;

**Activities**

**General description of your activities**: In the last year, I have spent ~50% of my time supporting users, ~30% of my time for instrumentation development/improvement to enhance "user friendliness", and ~20% of my time conducting HPT temperature scientific research projects, which includes:

(1). Commissioned the “Double-sided laser heating radial diffraction system”, and attracted 4 users on different projects.

(2) Developed, upgraded, and opened the tungsten resistive heater system whose temperature reached up to 1400C to the users, and attracted more than 11 users in the current cycle and next cycle;

(3). From Dec. 2016 to Nov. 2017, I have made 68 boron-kypton gaskets for 9 COMPRES/High pressure community users,

(4). In the case of long shutdown from Jan. 3rd to March 20, supported 28 users.

(5) Have been conducting and will continue to conduct my own resistive heating scientific research projects, for example, (a). MgO thermal expansion coefficient measurement using resistive heating, (b) melting determination of Iron at high pressure high temperature using resistive heating

(6). Publications: there are 4 published papers as co-author, and additional 5 submitted papers as co-author, with one of paper first author. In addition, at least two more manuscripts are in preparation.

(7). Now I am developing a new offline ruby system with multiple magnifications. In addition, I am working on my high pressure high temperature resistive heating project. In the future, I am very interested to develop a resistive heater for radial diffraction, and interested at thermal conductivity technique development at beamline 1222.

**R&D, and Scientific projects involved:**

(1). Commissioning “Double-sided laser heating radial diffraction system” on beamline 1222.

Due to its long arm of 270 side in the air and lack of support of its weight, the previous radial double-sided laser heating system can’t focs while heating. A newly designed and built of 270 side is directly sit on the table, which solve the defocused issue. Now the whole double-sided laser heating radial diffraction system work very well, and are open to the users.

This system has been used by Lowell Miyagi (Uni. Of Utah), and Bin Chen (HPSTAR), Cara Vennari (UC Santa Cruz), Rudy Wenk (UC Berkeley).

(2). Open the Tungsten external heater to users

A tungsten external heater in the reduced Ar+H2 for BX90 DAC has been developed, and the tests both in the lab and on beamline show that the heaters can reach up to 1700K. With specially designed membrane pressure generating mechanism, the sample volume vs temperature for heating up to 1200K at a given pressure of 16 GPa is reversible, at least close to reversible during heating-cooling, and this process should be called isobaric, or quasi-isobaric. The heater is designed to fit the regular BX90 cell with regular seats of 5.3 mm high and regular diamond of 2 mm in height. This resistive heating system has been open to users, and has attracted interests from.

**Sulgiye Park (Stanford Uni.),**

**Qiaoshi(Charles) Zeng (HPSATR),**

**Kuo Li (HPSTAR),**

**Jennifer Dionne (Stanford Uni.)**

**Bin Chen (Hawaii Uni.),**

**Nathan Wolf (Stanford Uni.)**

**Zhenxian Liu (Brookhaven National Lab),**

**Hengzhong Zhang (HPSTAR)**

**Bin Chen (HPSTAR)**

**Yabin Chen (UC Berkeley)**

**Budhiram Kulanand Godwal (UC Berkeley)**

**and myself.**

(3). Provide boron-kypton gaskets (totally **68**) for COMPRES community users.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Affiliate | Date | Qty of Gasket | Note |
| **Cara Vennari** | UCSC | Dec. 1, 2016 | 6 |  |
| Qiaoshi(Charles) Zeng | HPSTAR | Jan. 24, 2017 | 12 |  |
| Shizhong Yang | South Uni. | Feb. 24, 2017 | 6 |  |
| Mary Marguerite Reagan | Stanford | Mar. 13, 2017 | 4 |  |
| Jialin Lei | UCLA | Apr. 10, 2017 | 6 |  |
| **Cara Vennari** | UCSC | May 18, 2017 | 6 |  |
| Hengzhong Zhang | HPSTAR | July 5, 2017 | 2 | for BL 7. 3.1, ALS |
| Jialin Lei | UCLA | Sep. 11, 2017 | 6 |  |
| Mary Marguerite Reagan | Stanford | Sep. 19, 2017 | 20 | Partially done due to Laser miller down |

(4) High pressure high temperature research projects, like

a). MgO thermal expansion coefficient measurement using resistive heating

b) melting determination of Iron at high pressure high temperature using resistive heating

c). Other resistive heating projects.

(5) Developing a new off-line ruby system.

A new magnification changeable offline ruby system is under development. This system is more robust.

(6) “Thermal conductivity measurement technique development”. 2-D radial temperature map technique has been setup at beamline 12.2.2. to measure radial temperature distributions of laser-heated samples in the Diamond Anvil Cell. Rainey, E. S. G., and A. Kavner has developed a thermal conductivity technique by combining with numerical models. This project is to explore this technique and apply it to beamline 12.2.2.

**Publications and manuscripts.**

**Papers published**

1. Nisr, C., Y. Meng, A.A. MacDowell, J. Yan, V. Prakapenka, and S.-H. Shim, "Thermal expansion of SiC at high pressure-temperature and implications for thermal convection in the deep interiors of carbide exoplanets," Journal of Geophysical Research: Planets 122(1), 124-133 (2017). (doi:10.1002/2016JE005158) 12.2.2

2. Rittman, D.R., K.M. Turner, S. Park, A.F. Fuentes, J. Yan, R.C. Ewing, and W.L. Mao, "High-pressure behavior of A 2B 2O 7 pyrochlore (A=Eu, Dy; B=Ti, Zr)," Journal of Applied Physics 121(4), 045902 (2017). (doi:10.1063/1.4974871) 12.2.2

3. Zhang, F., Y. Wu, H. Lou, Z. Zeng, V.B. Prakapenka, E. Greenberg, Y. Ren, J. Yan, J.S. Okasinski, X. Liu, Y. Liu, Q. Zeng, and Z. Lu, "Polymorphism in a high-entropy alloy," Nature Communications 8, 15687 (2017). (doi:10.1038/ncomms15687) 12.2.2

4. Zhou, X., N. Tamura, Z. Mi, J. Lei, J. Yan, L. Zhang, W. Deng, F. Ke, B. Yue, and B. Chen, "Reversal in the Size Dependence of Grain Rotation," Physical Review Letters 118(9), 096101 (2017). (doi:10.1103/PhysRevLett.118.096101) 12.2.2,12.3.2

**Papers submitted**

1. J Yan, M Kunz, A Doran, A A MacDowell, Q Williams “A tungsten external heater for BX90 Diamond Anvil Cells with a range up to 1700 K”, submitted to AIRAPT26, IOP Journal of Physics: Conference Series (JPCS).

2. Dayong Tan, Xueting Liu, Yu Tian, Huifang Zhao, Yunhong He, Binbin Yue, Ho-Kwang Mao, Bin Chen, Jinyuan Yan, Wansheng Xiao, “Stability of pyrite-type platinum dioxide at pressure and temperature conditions of the Earth’s mantle” Submitted American Minerologist

3. Binbin Yue, Fang Hong, Zhenxiang Cheng, Shibo Li, Yanping Yang, Jinyuan Yan, Martin Kunz, Bin Chen, Ho-Kwang Mao “In situ investigation on the strength anisotropy and plastic deformation of Ti3AlC2 under high pressure” Submitted to Material Today.

4. Yuanjie Huang, Jianqi Qi, Lei Hu, Houwen Chen, Jinyuan Yan, Yanping Yang, Yu Deng, Tie-Cheng Lu, Bin Chen "The Reverse Hall-Petch Effect of Nano-Spinel MgAl2O4", submitted to International Journal of Plasticity.

5. Guoqing Geng, Jiaqi Li, Yang Zhou, Lin Liu, Jinyuan Yan, Martin Kunz, Paulo J. M. Monteiro" A high-pressure X-ray diffraction study of the crystalline phases in calcium aluminate cement paste" submitted to Cement and Concrete Research

**Papers in preparation**

1.“The current status of the double side laser heating system at beamline 1222, Advanced Light Source”

2. J Yan, Alastair A. MacDowell, Marin Kunz, Bin Chen, Earl Cornel, Edd Domning, Quentin Williams “How does fitting procedure affect temperatures deduced by full hot spot spectral fitting”

**Users supported**

There is about three (3) month shutdown from Dec. 2016 to March 23rd 2017 at ALS.

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| **Rudy Wenk** | **UC Berkeley** | **Dec 6, 2016** |
| **Paulo Monteiro** | **UC Berkeley** | **Dec. 20-21** |
| **Quentin Williams** | **University California, Santa Cruz** | **Mar 23,** |
| **Hans-Rudolf Wenk** | **University California, Berkeley** | **Mar 24-26** |
| **Quentin Williams** | **University California, Santa Cruz** | **Mar 31,** |
| **Quentin Williams** | **University California, Santa Cruz** | **April 20,** |
| **Sarah Tobert** | **University California, Los Angeles** | **May12-14** |
| **Quentin Williams** | **University California, Santa Cruz** | **May 19-20** |
| **Quentin Williams** | **University California, Santa Cruz** | **May 26,** |
| **Shizhong Yang** | **South University,** | **May 27-28** |
| **Quentin Williams** | **University California, Santa Cruz** | **May 26,** |
| **Quentin Williams** | **University California, Santa Cruz** | **July 14,** |
| **Qiaoshi Charles Zeng** | **HPStar, Shanghai, China** | **July 28-29** |
| **Quentin Williams** | **University California, Santa Cruz** | **Aug. 1-2,** |
| **Wendy Mao** | **Stanford University** | **Aug. 2-5** |
| **Budhiram Kulanand Godwal** | **UCB** | **Aug. 5-6** |
| **Jennifer Dionne** | **Stanford University** | **Aug. 16** |
| **Bin Chen** | **HPSTAR** | **Aug. 17-19** |
| **Qiaoshi Charles Zeng** | **HPStar, Shanghai, China** | **Sep. 8-10** |
| **Quentin Williams** | **University California, Santa Cruz** | **Sep. 13** |
| **Kuo Li** | **HPSTAR** | **Sep. 28** |
| **Sarah Tobert** | **University California, Los Angeles** | **Oct. 6-8** |
| **Oliver Tschauner** | **UNLV** | **Oct. 11** |
| **Rudy Wenk** | **UC berkeley** | **Oct. 18** |
| **Eric Meshot** | **LLNL** | **Oct. 25** |
| **Yabin Chen** | **UC Berkeley** | **Oct. 31** |
| **Rudy Wenk** | **UC Berkeley** | **Nov. 1** |
| **Cara Vennari** | **UC Santa Cruz** | **Nov. 2** |

**Proposals participated in writing (either for other users, for yourself to the synchrotron facility, or to outside agencies).**

1. Jinyuan Yan “Laser heating temperature accuracy investigation by Iron phase transition” to beamline 12.2.2.
2. Help Yabin Chen (UCB) “High-temperature high-pressure synthesis of non-equilibrium 2D materials ” to beamline 12.2.2.
3. Help Hengzhong Zhang (HPSTAR) “Phase stability of entropy-stabilized complex oxide at high temperature and high pressure”, to beamline 1222