Beamline Scientist Individual Annual Report (Nov. 2017 – Nov. 2018)

**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; HPT researches,

**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 high-pressure / high-temperature (HPT) scientific research projects. In detail this includes:

(1) Upgrading the existing tungsten wire heater system whose temperature reached up to 1700K, to make heating more user friendly, and efficient.

(2) Developing a more user friendly, and more efficient band heater, including to integrate it into our beamline operation system

(3) Developing more user friendly, and more efficient graphite resistive heater for radial diffraction research.

(4) Developing a new offline ruby system with variable magnification.

(5). Provided boron-kypton gaskets for beamline users for radial diffraction work,

(6). User support: In the case of long shutdown over two monthes, supported 36 users.

(7) My own resistive heating scientific research projects: (a). MgO thermal expansion coefficient measurement using resistive heating,

(8). Publications: there are 6 published papers as co-author, and an additional 11 submitted papers with two of them first author.

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

(1). External resistive heating techniques development, upgrade, including

~ upgrading the commissioned tungsten donut heater which can go up to 1700K,

~Upgrade the band heater to make it more user friendly, and more efficient, and integrate it into our beamline control system

~ Developing a more user friendly graphite heater for radial diffraction research,

(2) High pressure high temperature research projects on measurement of pressure dependent thermal expansion coefficient.

Pressure-dependent thermal expansion coefficients (αP) is a key parameter in the thermal equation of state. It is quantified the isobaric volume change over a given temperature range. Isobaric heating is hard to achieve. There are lots of reports reporting pressure up and down shift during both resistive heating and laser heating. In addition, there are big discrepancies among the existing few measurements of pressure-dependent thermal expansion coefficients (αP). In this project, an isobaric or semi-isobaric heating/cooling technique will be developed and pressure dependent thermal expansion coefficients (αP) of MgO will be determined.

(5) Dual magnification off-line ruby system development.

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

**Publications and manuscripts.**

**Papers published**

1. Geng, G., J. Li, Y. Zhou, L. Liu, J. Yan, M. Kunz, and P.M. Monteiro, "A high-pressure X-raydiffraction study of the crystalline phases in calcium aluminate cement paste," Cement and Concrete Research 108, 38-45 (2018). (doi:10.1016/j.cemconres.2018.03.004) 12.2.2
2. Geng, G., R.N. Vasin, J. Li, M.J. Qomi, J. Yan, H.-R. Wenk, and P.M. Monteiro, "Preferred orientation of calcium aluminosilicate hydrate induced by confined compression," Cement and Concrete Research 113, 186-196 (2018). (doi:10.1016/j.cemconres.2018.09.002) 12.2.2
3. Guo, C., Y. Yang, L. Tan, J. Lei, S. Guo, B. Chen, J. Yan, and S. Yang, "Unexpected pressure induced ductileness tuning in sulfur doped polycrystalline nickel metal," AIP Advances 8(2), 025216 (2018). (doi:10.1063/1.5022267) 12.2.2
4. Kunz, M., J. Yan, E.W. Cornell, E. Domning, C.E. Yen, A. Doran, C.M. Beavers, A.J. Treger, Q. Williams, and A.A. MacDowell, "Implementation and application of the peak scaling method for temperature measurement in the laser heated diamond anvil cell," Review of Scientific Instruments 89(8), 083903 (2018). (doi:10.1063/1.5028276) 12.2.2
5. Lei, J., M. Yeung, P.J. Robinson, R. Mohammadi, C.L. Turner, J. Yan, A. Kavner, A.N. Alexandrova, R.B. Kaner, and S. Tolbert, "Understanding How Bonding Controls Strength Anisotropy in Hard Materials by Comparing the High-Pressure Behavior of Orthorhombic and Tetragonal Tungsten Monoboride," The Journal of Physical Chemistry C 122(10), 5647-5656 (2018). (doi:10.1021/acs.jpcc.7b11478) 12.2.2
6. Zhang, F., H. Lou, S. Chen, X. Chen, Z. Zeng, J. Yan, W. Zhao, Y. Wu, Z. Lu, and Q. Zeng, "Effects of non-hydrostaticity and grain size on the pressure-induced phase transition of the CoCrFeMnNi high-entropy alloy," Journal of Applied Physics 124(11), 115901 (2018). (doi:10.1063/1.5046180) 12.2.2

**Papers submitted**

1. CHEN, Bin; Huang, Yuanjie; Xu, Jianing; Zhou, Xiaoling; Chen, Zhiqiang; Zhang, Hengzhong; Zhang, Jie; Qi, Jianqi; Lu, Tiecheng; Banfield, Jill; Yan, Jinyuan; Raju, Selva Vennila; Gleason, Arianna; Clark, Simon; MacDowell, Alastair"Revealing the Ductility of Nanoceramic MgAl2O4" submitted to Journal of Materials Research
2. Roman Vasin, Jiaqi Li, M. J. A. Qomi, Jinyuan Yan, Hans-Rudolf Wenk, Paulo J. M. Monteiro "Preferred Orientation of Calcium Aluminosilicate Hydrate Induced by Confined Compression" Submitted to Cement and Concrete Research
3. Jialin Lei, Michael Yeung, Reza Mohammadi, Christopher Turner, Jinyuan Yan, Richard Kaner, and Sarah Tolbert "Understanding the Mechanism of Hardness Enhancement in Tantalum-Substituted Tungsten Monoboride Solid Solutions" Submitted to JAP
4. Benyuan Cheng, Fei Zhang, Hongbo Lou, xiehang chen, Peter Liaw, Jinyuan Yan, Zhidan Zeng, yang ding, and Qiaoshi Zeng "Pressure-induced phase transition in the AlCoCrFeNi high-entropy alloy", submitted to APL
5. Yang Gao, Jinyuan Yan, Cheng Ji, Mi Zhou, Yanyan Zhang, Qinglin Wang, Yuqiang Li, Bao Liu, and Yanzhang Ma "Non-hydrostatic effect on pressure induced structural phase transition of MnWO4"
6. Guoqing Geng, Roman Nikolaevich Vasin, Jiaqi Li, Mohammad Javad Abdolhosseini Qomi, Jinyuan Yan, Martin Kunz, Hans-Rudolf Wenk, Paulo J. M. Monteiro "Compression-Driven Texture Formation of Calcium Aluminosilicate Hydrate and Its Influence on the Anisotropic Mechanical Property"
7. 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).
8. 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
9. 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”
10. 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.
11. Jinyuan Yan, Shizhong Yang "An alternate volume-pressure-temperature thermal equation of state for solid at high temperature-pressure", submitted to High Pressure Research

**Users supported**

1. General user support

There is about one month shutdown from Jan. 2 to Jan. 31, and more than onemonth shutdown between July 5 and Aug. 14.

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| --- | --- | --- | --- |
| **Jinyuan Yan** | **UC Santa Cruz** | **Feb. 13, 2018** |  |
| **Hemamala Karunadasa** | **Stanford** | **Feb. 15, 2018** |  |
| **Mary Reagon** | **Stanford** | **Feb. 16-18, 2018** |  |
| **Paulo Monteiro** | **UC Berkeley** | **Mar. 2-4, 2018** |  |
| **oliver tschauner** | **UNLV** | **Mar. 13, 2018** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **Mar. 17, 2018** |  |
| **Lucy Darago** | **UC Berkeley** | **Mar. 18, 2018** |  |
| **Sarah Tobert** | **UCLA** | **Mar. 23-25** |
| **Wendy Mao** | **Stanford** | **Apr. 20-21** |  |
| **XiaoLing Zhou** | **U Utah** | **Apr. 22,** |  |
| **ALis Stavrou** | **Livermoor** | **Dec 7, 2017** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **Apr. 26, 2018** |  |
| **Hengzhong Zhang** | **HPStar** | **Apr. 27-29** |  |
| **XiaoLing Zhou** | **U Utah** | **May 13** |  |
| **Qiaoshi Zeng** | **HPSTAR** | **May26-27** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **June 2** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **June 5** |  |
| **XiaoLing Zhou** | **U Utah** | **June 10** |  |
| **Kuo Li** | **HPSTAR** | **June 6-7** |  |
| **Hengzhong Zhang** | **HPStar** | **June 15-17** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **June 27** |  |
| **XiaoLing Zhou** | **U Utah** | **July 1** |  |
| **Mingqiang Hou** | **HPSTAR** | **July 1** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **Aug. 18** |  |
| **Sarah Tobert** | **UCLA** | **Aug. 31-Sep. 2** |
| **Jinyuan Yan** | **UC Santa Cruz** | **Sep. 10** |  |
| **Mingqiang Hou** | **HPSTAR** | **Sep. 11** |  |
| **Hengzhong Zhang** | **HPStar** | **Sep. 14-17** |  |
| **Paulo Monteiro** | **UC Berkeley** | **Oct. 5-6** |  |
| **Hemamala Karunadasa** | **Stanford** | **Oct. 19** |  |
| **Mingqiang Hou** | **HPSTAR** | **Oct. 28** |  |
| **Paulo Monteiro** | **UC Berkeley** | **Nov. 1-2** |  |
| **Shizhong Yang** | **Southern Uni.** | **Nov. 3** |  |
| **Mingqiang Hou** | **HPSTAR** | **Nov. 7** |  |
| **Jinyuan Yan** | **UC Santa Cruz** | **Dec. 19** |  |
| **Shizhong Yang** | **Southern Uni.** | **Dec. 20-21** |  |

(2). Support users or myself who conduct external resistive heating using the Tungsten external heater.

A tungsten external heater in the reduced Ar+H2 for BX90 DAC has been developed on beamline 1222, and the tests both in the lab and on beamline show that the heaters can reach up to 1700K. The heater has attracted interests from.

**Nate Robert Wolf, Standford, Feb. 15**

**Jinyuan Yan, UCSC, Feb. 13**

**Mingqiang Hou, HPSTAR, Feb. 28**

**Jinyuan Yan, March 17**

**Kuo Li, HPSTAR, June 6-7**

**Hengzhong Zhang, HPSTAR, June 15-16**

**Jinyuan Yan, June 27,**

**Mingqiang Hou, July 1st.**

**Mingqiang Hou, HPSTAR, Sep. 11**

**Weixin Liu, HPSTAR, Sep. 14**

**Mingqiang Hou, HPSTAR, Oct.28**

**Mingqiang Hou, HPSTAR, Nov. 7, 2018**

(3). Provided boron-kypton gaskets (totally **39**) for COMPRES community users who conducted radial diffraction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Affiliate | Beamtime Date | Qty of Gasket | Note |
| **Mary Reagon** | Stanford | Feb. 16, 2018 | 7 |  |
| Tobert | UCLA | Mar. 23, | 6 |  |
| Paul Monteria | UCB | Mar. 2 | 6 |  |
| Cara | ucsc | May ? | 2 |  |
| Cara | UCSC | ? | 2 |  |
| Tobert | UCLA | Aug. 31 | 6 |  |
| Paul Monteria | UCB | Oct. 5 | 4 |  |
| Paul Monteria | UCB | Nov. 1 | 4 |  |
| Shizhong Yang | Southern Uni | Nov. 3 | 2 |  |