## Oral Presentation

**Date:** 9:00~12:30, Jan. 16 (Tue.), 2018  
**Room:** Yeung Kin Man Academic Building B6605, Lift 3

<table>
<thead>
<tr>
<th>ID</th>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Affiliation</th>
<th>Chair</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>9:00~9:10</td>
<td>Welcome remarks</td>
<td>Jacob C. Huang</td>
<td>City University of Hong Kong</td>
<td>Prof. Xunli Wang</td>
</tr>
<tr>
<td>IS1</td>
<td>9:10~9:50</td>
<td>The measurement of physical properties of viscous metallic liquids with electrostatic levitation</td>
<td>Andreas Meyer</td>
<td>Deutsches Zentrum für Luft- und Raumfahrt (Germany)</td>
<td>Prof. Xunli Wang</td>
</tr>
<tr>
<td>IS2</td>
<td>9:50~10:30</td>
<td>Effect of compositional change on the glass forming ability of Cu-Zr alloys: Stability of liquid and glass</td>
<td>Geun Woo Lee</td>
<td>Korea Research Institute of Standards and Science (Korea)</td>
<td>Prof. Xunli Wang</td>
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<td></td>
<td>10:30~10:40</td>
<td>Group photo</td>
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<td></td>
<td>10:40~11:00</td>
<td>Tea-break</td>
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<tr>
<td>IS3</td>
<td>11:00~11:40</td>
<td>Supercritical phenomenon in systems with liquid-liquid phase transition</td>
<td>LiMei Xu</td>
<td>Peking University</td>
<td>Prof. Baolong Shen</td>
</tr>
<tr>
<td>IS4</td>
<td>11:40~12:20</td>
<td>Structural signature in dynamic crossover phenomena in metallic glass-forming liquids</td>
<td>Maozhi Li</td>
<td>Renmin University of China</td>
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<tr>
<td></td>
<td>12:30~14:00</td>
<td>Lunch</td>
<td></td>
<td>House of Canton</td>
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## Oral Presentation

**Date:** 9:00~12:30, Jan. 17 (Wed.), 2018  
**Room:** Yeung Kin Man Academic Building B6605, Lift 3

<table>
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<tr>
<th>ID</th>
<th>Time</th>
<th>Title</th>
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<th>Affiliation</th>
<th>Chair</th>
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<tbody>
<tr>
<td>IS5</td>
<td>9:00~9:40</td>
<td>Research on the effects of melt purification on the undercooling and solidification behavior of glassy alloys</td>
<td>Kefu Yao</td>
<td>Tsinghua University</td>
<td>Prof. Yong Yang</td>
</tr>
<tr>
<td>IS6</td>
<td>9:40~10:20</td>
<td>Effects of minor alloying Si and Cu additions in formation of ferromagnetic bulk metallic glasses</td>
<td>Baolong Shen</td>
<td>Southeast University</td>
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<td></td>
<td>10:20~10:30</td>
<td>Tea-break</td>
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<tr>
<td>IS7</td>
<td>10:30~11:10</td>
<td>Synchrotron high-energy X-rays for in-situ study of phase transition in supercooled liquids</td>
<td>Yang Ren</td>
<td>Argonne National Laboratory (USA)</td>
<td></td>
</tr>
<tr>
<td>IS8</td>
<td>11:10~11:50</td>
<td>Local structural fluctuations from liquid state and their effects on metallic melts</td>
<td>Chae Woo Ryu</td>
<td>Seoul National University (Korea)</td>
<td>Prof. Limei Xu</td>
</tr>
<tr>
<td>IS9</td>
<td>11:50~12:30</td>
<td>Inter-diffusion and its correlation with dynamical cross correlation in liquid Ce$<em>{80}$Ni$</em>{20}$</td>
<td>Bo Zhang</td>
<td>Hefei University of Technology</td>
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<tr>
<td></td>
<td>12:30~14:00</td>
<td>Lunch</td>
<td>City Chinese Restaurant (8th floor)</td>
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</table>
## Oral Presentation

**Date:** 9:00~17:00, Jan. 18 (Thu.), 2018  
**Room:** Lau Ming Wai Academic Building 6208

<table>
<thead>
<tr>
<th>ID</th>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Affiliation</th>
<th>Chair</th>
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<tbody>
<tr>
<td>IS10</td>
<td>9:00~9:40</td>
<td>Pelican –A time of flight cold neutron spectrometer - Scientific outcomes of the first three years operation</td>
<td>Dehong Yu</td>
<td>Australian Nuclear Science and Technology Organisation (Australia)</td>
<td>Prof. Kefu Yao</td>
</tr>
<tr>
<td>IS11</td>
<td>9:40~10:20</td>
<td>CSNS SANS: The end of the beginning</td>
<td>Yubin Ke</td>
<td>Institute of High Energy Physics, Chinese Academy of Science</td>
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<td></td>
<td>10:20~10:30</td>
<td>Tea-break</td>
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<tr>
<td>IS12</td>
<td>10:30~11:10</td>
<td>Visualizing kinetic pathways of homogeneous nucleation in colloidal crystallization</td>
<td>Lei Xu</td>
<td>Chinese University of Hong Kong</td>
<td>Prof. Lina Hu</td>
</tr>
<tr>
<td>IS13</td>
<td>11:10~11:50</td>
<td>Critical-like behaviors and glass transitions in dense monolayers of colloidal ellipsoids</td>
<td>Yilong Han</td>
<td>Hong Kong University of Science and Technology</td>
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</tr>
<tr>
<td>IS14</td>
<td>11:50~12:30</td>
<td>In-situ study of hidden amorphous phase transitions in metallic glasses</td>
<td>Si Lan</td>
<td>Nanjing University of Science and Technology</td>
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<tr>
<td></td>
<td>12:30~14:00</td>
<td>Lunch</td>
<td>An Nam</td>
<td></td>
<td>Prof. Xunli Wang</td>
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<tr>
<td></td>
<td>14:15~17:15</td>
<td>Discussion on design of electrostatic levitator</td>
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<td></td>
<td>16:00~16:20</td>
<td>Tea-break</td>
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<tr>
<td></td>
<td>18:00</td>
<td>Bus to Restaurant</td>
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<tr>
<td></td>
<td>18:30</td>
<td>Dinner （Speakers only）</td>
<td>Chao Yang Restaurant</td>
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## Date: 9:00~12:00 Jan. 19 (Fri.), 2018
## Room: Lau Ming Wai Academic Building 6208

<table>
<thead>
<tr>
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<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Affiliation</th>
<th>Chair</th>
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</thead>
<tbody>
<tr>
<td>IS15</td>
<td>9:00~9:40</td>
<td>Fast secondary relaxation, anelasticity and plasticity initiation in metallic glass</td>
<td>Yong Yang</td>
<td>City University of Hong Kong</td>
<td>Prof. Maozhi Li</td>
</tr>
<tr>
<td>IS16</td>
<td>9:40~10:20</td>
<td>Competitions between relaxation modes: Their role in determining properties of metallic glasses</td>
<td>Lina Hu</td>
<td>Shangdong University</td>
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<td>10:20~10:30</td>
<td>Tea-break</td>
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<tr>
<td>IS17</td>
<td>10:30~11:10</td>
<td>Microscopic origin of the logarithmic relaxation process in molecular glass-forming liquids</td>
<td>Suresh Mavila</td>
<td>City University of Hong Kong</td>
<td>Prof. Bo Zhang</td>
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<td>Chathoth</td>
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<tr>
<td>IS18</td>
<td>11:10~11:50</td>
<td>High glass-forming ability with loosely packed microstructure modulated by Al alloying</td>
<td>Chenchen Yuan</td>
<td>Southeast University</td>
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<tr>
<td></td>
<td>11:50~12:00</td>
<td>Closing remarks</td>
<td>Xunli Wang</td>
<td>City University of Hong Kong</td>
<td></td>
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<tr>
<td></td>
<td>16:30</td>
<td>Everyone is invited to a distinguished lecture by Prof. Yifang Wang</td>
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The Measurement of Physical Properties of Viscous Metallic Liquids with Electrostatic Levitation

Andreas Meyer, Fan Yang

1 Institute of Materials Physics in Space, German Aerospace Center, Cologne, Germany

We investigate vitrification of Zr-based viscous liquids from the melt to the glass transition in-situ with container-less processing. Electrostatic levitation gives access to the measurement of temperature, density and in combination with X-ray diffraction to the total structure factor. Free radiation cooling of the sample allows the measurement of the specific heat over constant emissivity. Combined with neutron diffraction and quasielastic neutron scattering, electrostatic levitation gives access to the measurement of partial structure factors, structural relaxation and atomic diffusion with unequalled accuracy so far. In this presentation new developments the benefits and limitations of electrostatic levitation for the measurements of properties of supercooled viscous metals will be discussed. Further developments of electrostatic levitation for application in the laboratory, on large scale facilities i.e. neutron and synchrotron sources, as well as on sounding rockets in space are presented.
Effect of Compositional Change on the Glass Forming Ability of Cu-Zr Alloys: Stability of Liquid and Glass

Geun Woo Lee$^{1,2}$

$^1$Division of Convergence Technology, Korea Research Institute of Standards and Science, 305-340, Republic of Korea

$^2$Department of Nanoscience, University of Science and Technology (UST), Daejeon 305-350, South Korea

Glass forming ability (GFA) of bulk metallic glasses (BMG) has been an open question for last decades. Although it is known that GFA is originated from thermodynamics and kinetics (i.e., stability of liquid and glass), it has never disentangled due to the complexity of structure and compositions of the BMGs. In this regards, Cu-Zr alloys have been a candidate to reveal the origin of GFA. However, Cu-Zr alloys show strong dependence of composition to form the BMGs, which has not been clearly addressed, although peculiar maxima in density, thermal expansion, and enthalpy difference of crystal-amorphous imply the better GFA in Cu-Zr alloys. Here, we investigate a correlation of compositional change and glass forming ability by temperature-time transformation diagram of Cu-Zr alloys which is measured by electrostatic levitation technique. We find three maxima in undercoolability, persistent time of supercooled liquid, and crystal-liquid interfacial free energy. The results reveal that the compositional change yields different effect on GFA of the Cu-Zr BMGs. We also demonstrate the relation of the crystal-liquid interfacial free energy and medium range order in quasicrystals.
Supercritical Phenomenon in Systems with Liquid-Liquid Phase Transition

Limei Xu¹

¹International Center for Quantum Materials and School of Physics, Peking University, China

There are group of materials such as water, Ge, and Si, Ce, and Ga, showing anomalies different from most of other materials (e.g., two amorphous solids and negatively sloped melting curve). Liquid-liquid phase transition scenario was proposed to explain such anomalies. It attributes such anomalies to the existence of a hypothesized liquid-liquid critical point (LLCP) usually buried deep in the supercooled region and very difficult to experimentally confirm due to crystallization. In this talk, I will discuss our model studies on the thermodynamic, dynamic and structural properties in the vicinity of the LLCP in the supercritical region and investigate how we understand the anomalous properties of such group of materials in terms of liquid-liquid phase transition.
Structural Signature in Dynamic Crossover Phenomena in Metallic Glass-Forming Liquids

Maozhi Li

1 Department of Physics, Renmin University of China, Beijing 100872 China

Molecular dynamics simulations were performed to investigate dynamic evolution in metallic glass-forming liquids during quenching from high temperature above melting point down to supercooled region. Two crossover temperatures $T_A$ and $T_S$ ($T_A > T_S$) are identified and their physical meanings are clarified. $T_A$ and $T_S$ are found to be not only the sign of dynamic crossover phenomena, but also the manifestation of two key structure correlation lengths $\xi$. As temperature decreases below $T_A$, $\xi$ goes beyond the nearest-neighbor distance, resulting in the Arrhenius-to-non-Arrhenius transition of structural relaxation time and the failure of Stokes-Einstein (SE) relation. As $T_S$ is traversed, the increase rate of $\xi$ reaches the maximum, leading to the simultaneous appearance of dynamical heterogeneity and fractional SE relation. It is further found that structure correlation increases much faster than dynamic correlation, playing a role of structural precursor for dynamic evolution in liquids. Thus, a universal structural link is established for deeper understanding dynamic crossover phenomena.

References:
Research on the Effects of Melt Purification on the Undercooling and Solidification Behavior of Glassy Alloys

K. F. Yao

School of Materials Science and Engineering, Tsinghua University, Beijing 100084, P.R. China

It is known that melt purification could remove the inhomogeneity nucleus and enhance the undercooling of the alloy. Here, we improved the melt purification technology and got large undercooling for Pd-Ni-P and Fe-Ni-P-B alloys. It shows at different undercooling, the solidification behavior, microstructures and properties of these alloys are quite different. At large undercooling, nanostructured alloy could be directly prepared. At suitable condition, bulk amorphous alloy could also be obtained. It indicates that the glass-forming ability of the studied alloys could be significantly improved through melt purification. The effect of melt purification on the undercooling and the solidification behavior of the alloys has been discussed. It implies that together with melt purification large undercooling of the alloy melts could be obtained with melt levitation method.
Effects of Minor Alloying Si and Cu Additions in Formation of Ferromagnetic Bulk Metallic Glasses

Baolong Shen\textsuperscript{1}, Xue Lin\textsuperscript{1}, Genglei Zhang\textsuperscript{1}, Hou Long\textsuperscript{1}, Chenchen Yuan\textsuperscript{1,2} and Qiaoshi Zeng\textsuperscript{1}

\textsuperscript{1}School of Materials Science and Engineering, Southeast University, Jiangning, Nanjing 211189, China
\textsuperscript{2}Department of Physics, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong

In this talk, the effects of minor alloying Si and Cu additions on glass formation and properties of Gd- and CoFe-based bulk metallic glasses (BMG) will be reported. It was found that minor alloying Si is largely effective to improve glass-forming ability (GFA) of the Gd-based BMG, the size of the GdCoAl BMG was increased from 2 to 7 mm as Si content increasing from 0 to 0.5 at\%. The comparable large magnetic entropy change of 8.41 Jkg\textsuperscript{-1}K\textsuperscript{-1} and corresponding refrigerant capacity of 757 Jkg\textsuperscript{-1} of this metallic glass were also obtained at 105 K under the field change of 5 T. For the Cu addition, although minor alloying is effective to improve the plastic strain to 3.7\%, combined with superhigh fracture strength larger than 4000 MPa and good soft magnetic properties, through precipitation of $\alpha$-(Fe, Co) nanoparticles in the glass matrix, which will hinder the propagation of the shear band, leading to promote the generation of multiple shear bands and enhance the plasticity, but the effectiveness on GFA seems to be different with different CoFe-based BMG system, the reason will be discussed at the workshop.
Synchrotron High-Energy X-Rays for In-Situ Study of Phase Transition in Supercooled Liquids

Yang Ren 1

1 X-ray Science Division, Advanced Photon Source, Argonne National Laboratory, Argonne, IL 60439, USA

The availability of high-brilliance high-energy x-rays generated at accelerator based synchrotron radiation sources has significantly advanced the field of materials research, especially for in-situ studies of solid and liquid materials in realistic conditions. In this talk, we will briefly introduce synchrotron high-energy x-ray total scattering and pair-distribution-function analysis. We will emphasize the uniqueness and importance of synchrotron high-energy x-rays in structural characterization of glassy, amorphous and non-crystalline materials. Technical details and methodologies and some recent results on in-situ high-energy x-ray diffraction study of phase transition in amorphous alloys and liquids will be presented. We will also discuss scientific research opportunities with synchrotron high-energy x-rays in the field of phase transition in supercooled liquids and supercritical fluid.
Local Structural Fluctuations from Liquid State and their Effects on Metallic Melts

Chae Woo Ryu¹, Takehiko Ishikawa², Kenneth F. Kelton³, Geun Woo Lee⁴ and Eun Soo Park¹

¹Research Institute of Advanced Materials, Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea
²Department of Physics and Institute of Materials Science and Engineering, Washington University, St. Louis, Missouri 63130, USA
³Japan Aerospace Explanation Agency, 2-1-Isengen, Tsukuba, Ibaraki, 305-8505, Japan
⁴Department of Nano Science, University of Science and Technology, Daejeon 34113, Republic of Korea

An analytic scheme to connect the atomic structure and dynamic behavior in metallic melts is ambiguous. The challenge is how to account the structural heterogeneities at different time scale and length scale of metallic melts which enables the viscosity of metallic melts to change in contrasting ways. Here we demonstrate the formation behavior of amorphous clusters in Zr-Cu-Al-Ag alloy and their effects on fragilities in metallic glass forming alloy system via in situ synchrotron X-ray scattering experiments in a contactless environment using an electrostatic levitator (ESL). The evolution of Ag enriched amorphous clusters over nano scales are the consequence of a positive heat of mixing between elements, inducing a drastic change in the temperature dependence of relaxation processes. Our experimental results represent a possible way of linking atomic level structural evolution to relaxation dynamics coupled with different length scale heterogeneities. This relationship opens up opportunities to fabricate alloys with tailored fragility by rationally tuning the chemical composition of the alloy according to general principles.
Inter-Diffusion and its Correlation with Dynamical Cross Correlation in Liquid Ce$_{80}$Ni$_{20}$

Zhang Bo $^1$

$^1$School of Materials Science and Engineering, Hefei University of Technology, Hefei 230009, China

We reported the inter-diffusion coefficients in liquid Ce$_{80}$Ni$_{20}$ measured by the sliding cell technique. Combined with the self-diffusion data of Ni measured by quasi-elastic neutron scattering in the literature, it was found that the relationship between inter-diffusion and self-diffusion in liquid Ce$_{80}$Ni$_{20}$ was strongly deviated from the standard Darken equation with an abnormally small dynamical cross correlation factor $S$ (the so called Manning factor) in a range of 0.6~0.8, less than unity in standard systems. Through the calculated distinct diffusion coefficient and its deviation from the standard one, it was discovered that the small $S$ value was directly originated from enhanced distinct diffusion between Ce and Ni atoms and reduced distinct diffusion between Ni and Ni atoms. Because the inter-atomic interaction was not considered in the standard liquids, the present small $S$ factor and intrinsic distinct diffusion coefficients were believed to be resulted from the chemical interaction between Ce and Ni in the liquid. The results provide new evidence of the dynamic cross correlation in liquid diffusion, and thus shed light on the understanding of the correlation between dynamics and structure in liquid alloys.
PELICAN –a Time of Flight Cold Neutron Spectrometer - Scientific Outcomes of the First Three Years Operation

Dehong Yu

1Australian Centre for Neutron Scattering, Australian Nuclear Science and Technology Organisation, New Illawarra Road, Lucas Heights, 2234, Australia

The time-of-flight direct-geometry neutron spectrometer, Pelican, has been in user program since 2014 at the OPAL research reactor, at the Australian Nuclear Science and Technology Organisation (ANSTO). The Pelican instrument was designed to meet the diverse requirements of the Australian scientific community from physics, chemistry, material science, to biology. A wide range of research fields is covered. These include crystal-field excitations, phonon densities of states, magnetic excitations for various multifunctional materials including high Tc superconductors, novel magnetic, thermoelectric, ferroelectric and piezoelectric materials; molecular dynamics in hydrogen-bonded and storage materials, catalytic materials, cements, soils and rocks; and water dynamics in proteins and ion diffusion in membranes. Polarized neutrons and polarisation analysis option makes the full use of the neutron spin to study magnetism and to separate the coherent and incoherent scatterings.

In this presentation, the performance and capabilities of the instrument will be demonstrated with several systems studied using quasi-elastic and inelastic neutron scatterings. These include water dynamics around amino acids, crystal field excitations in magnetic molecular crystals, low energy magnetic excitations in spin frustrated magnet, oxygen diffusion in solid oxide conductors and phonon density of states in thermoelectric materials. The potential application to study dynamics of supercooled liquids will be discussed.
CSNS SANS: The End of the Beginning

Y.B. Ke\textsuperscript{1,2}, Juzhou Tao

\textsuperscript{1} Institute of High Energy Physics, Chinese Academy of Sciences (CAS), Beijing 100049, China
\textsuperscript{2} Dongguan Neutron Science Center, Dongguan 523803, China

The vision for an advanced accelerator-driven neutron source in China started in the late 90s, followed by the China Spallation Neutron Source (CSNS) breaking ground in Canton in 2013 and obtaining first neutrons in late 2017. We report our work on one of the three day-one instruments, the CSNS Small-Angle Neutron Spectrometer (SANS). The latest and preliminary hot-commissioning results are encouraging, and we are beginning to explore scientific opportunities as well as cultivating the user community.
Visualizing Kinetic Pathways of Homogeneous Nucleation in Colloidal Crystallization

Lei Xu

1 Physics Department, The Chinese University of Hong Kong, Shatin, NT, Hong Kong

During liquid-to-solid transition, particles pass through multiple intermediate structures to reach the final state. However, the exact pathways remain elusive, due to the difficulty of direct observation. Using various colloidal systems, we experimentally study the evolutions in both symmetry and density, and visualize kinetic pathways with single-particle resolution. Before nucleation, we observe relatively-ordered precursor structures in multiple symmetries, which subsequently convert into metastable solids. During this precursor-to-solid conversion, surprisingly, two major cross-symmetry pathways are always observed, regardless of the final state and the interaction potential. During this same process, moreover, we discover a broad decoupling between density variation and symmetry development, and reveal that nucleation rarely starts from the densest regions. These findings are universally observed in all our samples, raising the possibility of finding a unified picture for the complex crystallization kinetics in colloidal systems [1]

References:
Critical-Like Behaviors and Glass Transitions in Dense Monolayers of Colloidal Ellipsoids

Yilong Han\(^1\) and Zhongyu Zheng\(^1,2\)

\(^1\)Department of Physics, The Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China
\(^2\)Institute of Mechanics, Chinese Academy of Sciences, Beijing 100190, China

Colloidal spheres have been intensively used as model systems for the study of supercooled liquids and glass transitions. However, colloidal glasses composed of anisotropic particles have been much less studied. Here we measured both the translational and rotational glassy dynamics of monolayers of supercooled liquids composed of colloidal micro-ellipsoids by video microscopy. We observed a one-step glass transition (supercooled liquid $\rightarrow$ conventional glass) at ellipsoid’s aspect ratio $a/b < 2.5$, and a two-step transition (supercooled liquid $\rightarrow$ orientational glass $\rightarrow$ double glass) at $a/b > 2.5$ [1]. Conventional glass and orientational glass share common features, but also exhibit opposite behaviors. For example, the fastest translating and rotating particles becomes anticorrelated in space when $a/b > 2.5$. In addition, we revealed rich correlations between the dynamics heterogeneity (e.g. fast and slow clusters) and structural properties (e.g. glassy and low-entropy clusters) [2]. The mobile and immobile cluster sizes diverge at the mode-coupling critical point $\phi_c$ and at the ideal glass-transition point $\phi_0$ respectively. We found the same Ising criticality at $\phi_0$ for glassy orders, local structural entropies and slow-moving clusters [3], reflecting a thermodynamic nature of the glass transition at $\phi_0$. A different criticality is found at $\phi_c$ for the fast-moving clusters, reflecting a dynamic glass transition.

References:
In-situ Study of Hidden Amorphous Phase Transitions in Metallic Glasses

S. Lan$^{1,2}$, X.-L. Wang$^{2,3}$

$^1$Herbert Gleiter Institute of Nanoscience, Nanjing University of Science and Technology, Nanjing, China
$^2$Department of Physics and Materials Science, City University of Hong Kong, Hong Kong SAR, China
$^3$Center on Neutron Scattering, City University of Hong Kong Shenzhen Research Institute, Shenzhen, China

Unlike crystalline alloys with periodic atomic structure, atoms in metallic glasses are disordered at long-range scale but they retain a certain degree of local ordering, which results in a series of complex kinetics and dynamic behaviors. There is a well-known anomalous exothermic peak (AEP) far below crystallization temperatures in prototypical Pd-Ni-P glasses [1], arguably the best glass-forming alloys, which has been recognized in a series of metallic glasses for half century long. The contradictory explanations of the mysterious AEP in the community hindered the research and development of new metallic glasses due to the lack of consistent structure evidence via in-situ characterizations. Here we show, using a suite of in-situ experimental techniques, including simultaneous small angle neutron scattering-calorimetry, high-energy X-ray diffraction and electron microscopy, that Pd-Ni-P alloys have a hidden amorphous phase in the supercooled liquid region. The anomalous exothermal peak is the consequence of a polyamorphous phase transition between two supercooled liquids, involving a change in the packing of atomic clusters over medium-range length scales as large as 18Å (Fig. 1). With further temperature increase, the alloy reenters the supercooled liquid phase, which forms the room-temperature glass phase upon quenching. The outcome of this study raises a possibility to manipulate the structure and hence the stability of metallic glasses through heat-treatment.

Reference:
Fast Secondary Relaxation, Anelasticity and Plasticity Initiation in Metallic Glass

Q. Wang\textsuperscript{1,2}, X.D. Liu\textsuperscript{1}, J. J. Liu\textsuperscript{2}, Y. F. Ye\textsuperscript{1}, T. T. Liu\textsuperscript{2}, C.T. Liu\textsuperscript{1}, J. Lu\textsuperscript{1}, Y.Yang\textsuperscript{1}

\textsuperscript{1} Center for Advanced Structural Materials, Department of Mechanical and Biomedical Engineering, City University of Hong Kong, Kowloon, Hong Kong SAR, China
\textsuperscript{2} Laboratory for Microstructures, Institute of Materials, Shanghai University, China

It has long been recognized that the relaxation spectrum of glassy solids is intrinsically connected to their disordered structural features and deformation behaviors. However, such connections still remain elusive for metallic glasses. Here, through the extensive study of a variety of metallic glasses over a wide range of temperatures, we provide the compelling evidence for the existence of a universal fast secondary relaxation process, which occurs at a temperature far below the glass transition point with a low activation energy (0.3-0.6eV). Furthermore, it is demonstrated that these fast relaxation modes, while strongly correlated with anelasticity in metallic glasses, affects initiation of plasticity in them. By exciting the fast relaxation process, multiple shear banding are triggered as opposed to single shear banding in metallic glasses, which leads to an unusual brittle-to-ductile transition in malleability, being fundamentally different from the ordinary one commonly observed in crystalline alloys.

References:
[1] Atomistic free-volume zones and inelastic deformation of metallic glasses, JC Ye, J Lu, CT Liu, Q Wang, Y Yang, Nature Materials 9 (8), 619-623
[3] Unusual fast secondary relaxation in metallic glass, Q Wang, ST Zhang, Y Yang, YD Dong, CT Liu, J Lu, Nature Communications 6, 7876
Materials Today 20 (6), 293-300.
Competitions Between Relaxation Modes: Their Role in Determining Properties of Metallic Glasses

Lina Hu

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Different kinds of relaxations (etc., primary \( \alpha \) relaxation and slow \( \beta \) relaxation) exist in metallic glasses. In the present work, we focus on two parts: one concerns how the relaxation modes in the supercooled liquids affect the relaxation pattern of glassy solids; the other concerns the correlation between the evolution of different relaxations and the F-S transition phenomenon. It has been found that the different competitions between the two relaxation modes could result in different relaxation patterns of metallic glasses below \( T_g \). The sub-\( T_g \) enthalpy relaxation in glasses far from equilibrium i.e., hyperquenched glasses is usually manifested as a monotonic increase in both the onset temperature and the extent of enthalpy recovery with increasing the annealing temperature. However, an abnormal three-steplike relaxation pattern has been observed in hyperquenched Cu-based metallic glasses below \( T_g \), i.e., the usual monotonic increase is inverted when the annealing temperature increases to a critical value [1]. This abnormal relaxation pattern is a thermodynamic evidence for the existence of non-monotonic structural evolution in supercooled liquid region of metallic glass-forming liquids, which is believed to relate to the dynamic fragile-to-strong transition [2]. Based on a survey of 22 metallic glasses, it is intriguing to notice that the ratio \( r \) between the activation energy of \( \alpha \) relaxation and slow \( \beta \) relaxation, \( E_\alpha \) and \( E_\beta \) has a negative correlation with the F-S transition factor \( (f) \), i.e., the ratio \( r \) increases with \( f \) decreasing [3]. The finding indicates that the slow \( \beta \) relaxation plays a dominant role in the F-S transition. This work provides new insight into the microscopic mechanism of the F-S transition, and creates strong basis for predicting whether and to what extent the F-S transition occurs in supercooled liquids.

References:
Microscopic Origin of the Logarithmic Relaxation Process in Molecular Glass-Forming Liquids

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Logarithmic relaxation is a unique relaxation process exhibited by a few molecular liquids and bio-molecules. However, the microscopic origin of logarithmic relaxation is still unclear. To understand the origin of this process, we studied two liquids that exhibit logarithmic relaxation in confinement state using quasi-elastic neutron scattering (QENS) and depolarized dynamic light scattering (DDLS). Although the intermolecular potential of the liquids is drastically different in the soft-confined state from the bulk liquids, we observed that the logarithmic relaxation still persists. Our results indicate that the intermolecular potential does not play a role in determining the logarithmic relaxation process. The coupling of rotational and translational relaxation processes could be the origin of the logarithmic relaxation process exhibited by the molecular liquids.
High Glass-Forming Ability with Loosely Packed Microstructure Modulated by Al Alloying

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In hard sphere model system such as metallic glasses, packing density has close correlation with glass formation. In general knowledge, the highly packed density is beneficial to the formation of metallic glasses. In this work, surprisingly, we found that the reduction of packing fraction in Al-containing Zr-based alloy systems accompanies with improved glass-forming ability (GFA). The studies of ²⁷Al isotropic shifts and spin-lattice relaxation time by nuclear magnetic resonance combined with ab initio molecular dynamics simulations shows that the hybridized bonding between metalloid-like Al and transition metal element favors the propagation of socialized Al- and Co-centered clusters at the Co-preferred environment surrounded by Zr atoms, which induces a frustrated packing structure and high GFA. Importantly, these results imply that the connectivity of atomic pairs is more dominant than packing state in determining GFA in these alloy systems. Our studies might shed a new light on mechanism of the glass formation besides of the traditional packing view, and provide a novel rout for exploring new glass systems with excellent properties.
City University Distinguished Lecture Series

Speaker
Professor Yifang Wang
Director of the Institute of High Energy Physics (IHEP)
Chinese Academy of Sciences

The Quest of Infinity

on
Friday, 19 January 2018 at 4:30 pm
at
Senate Room
19/F Lau Ming Wai Academic Building
City University of Hong Kong
Tat Chee Avenue, Kowloon

Abstract
The quest to infinity has been one of the main driving force of the human civilization. Our society actually benefited a lot from the study of infinitely small — particle physics and infinitely large — cosmology. In this talk, Professor Wang will introduce what his group have achieved, where they are now, what they are doing, and where they are going. In particular, Professor Wang will discuss the role of China in this respect.

Biography
Professor Yifang Wang is an experimental particle physicist, and currently the director of the Institute of High Energy Physics (IHEP) of Chinese Academy of Sciences. He is a member of Chinese Academy of Sciences, the Third World Academy of Sciences, and a foreign member of Russian Academy of Sciences.

Professor Wang worked on e^+e^- collider physics and led the design, construction and science effort of the BESIII experiment at the Beijing Electron-Positron Collider. He proposed the Circular e^+e^- Collider (CEPC) as a Higgs factory in China. He initiated the Daya Bay reactor neutrino experiment in China and led its design, construction and science effort. He is now leading the JUNO experiment.

Professor Wang published more than 300 papers and is a recipient of the Panofsky Prize for Experimental Particle Physics, the Nikkei Asia Prize for Science, Technology and Environment, the Breakthrough Prize in Fundamental Physics, and the Pontecorvo prize.

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E-mail: enquiry.hpme@harbour-plaza.com

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- Restaurant information

**House of Canton** (翰騰閣) *(Lunch)*

12:30~14:00, Jan. 16 (Tue.), 2018

Address: Shop LG2-40, Festival Walk, 80 Tat Chee Road, Kowloon Tong

Website: [http://www.houseofcanton.com/](http://www.houseofcanton.com/)

**City Chinese Restaurant** (城大中餐厅) *(Lunch)*

12:30~14:00, Jan. 17 (Wed.), 2018

Address: 8/F Amenities building, Cityu


**An Nam** (安南) *(Lunch)*

12:30~14:00, Jan. 18 (Thu.), 2018

Address: Shop L1-20, Festival Walk, 80 Tat Chee Road, Kowloon Tong


**Chao Yang Restaurant** (朝阳饭庄) *(Dinner)*

18:30, Jan. 18 (Thu.), 2018

Address: 27/F iSquare, 63 Nathan Road, Tsimshatsui, Kowloon