CAMT Seminar

“High-density, well-ordered yet high-energy metallic glass phase constructed by pressure-promoted thermal rejuvenation”

Dr. Narumasa Miyazaki

Institute for NanoScience Design, Osaka University
1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan
Email: miyazaki@insd.osaka-u.ac.jp

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Abstract

Metallic glasses have unique mechanical properties such as high strength, high elastic strain limit and high wear resistance, and has been promised to use as structural materials. However, the brittle failure is a disadvantage of metallic glasses to use practical application, thus it is important to improve the plastic deformability. In this study, pressurized-thermal loading process was newly proposed, which improve plastic deformability by realizing less relaxed glassy state, so called rejuvenation[1][2]. The reason of improvement of plastic deformability in this rejuvenated metallic glass is revealed by theoretically approach and atomistic viewpoint. Moreover, the glassy state constructed by pressurized cooling process is unique glassy phase owing high-density well-ordered yet high-energy[1].

By using molecular dynamics, I propose the application of compressive hydrostatic pressure during the glass-forming quenching process and demonstrates highly rejuvenated glass states that have not been attainable without the application of pressure. The pressure-promoted rejuvenation process increases the characteristic short- and medium-range order, even though it leads to a higher-energy glassy state. This “local order” - “energy” relation is completely opposite to conventional thinking regarding the relation, suggesting the presence of a well-ordered high-pressure glass/high-energy glass phase. Moreover, the rejuvenated glass made by the pressure-promoted rejuvenation exhibits greater plastic performance than as-quenched glass and greater strength and stiffness than glass made without the application of pressure. Furthermore, I discuss about the relationship between this unique less-relaxed state and “anti free-volume[3]”.

References

[1] N. Miyazaki, M. Wakeda, Y-J. Wang and S. Ogata, npj Comp. Mater., accepted.
[2] M. Wakeda, J. Saida, J. Li and S. Ogata, Sci.Rep. 5, 10545 (2015).
[3] D. Srolovitz, K. Maeda, V. Vitek, and T. Egami, Philos. Mag. A 44, 847 (1981).

(Host: Satoshi Hamaguchi Ext：7913)