Plenary Lectures PL01

Prof. Lu Jian

City University of Hong Kong

• Centre for Advanced Structural Materials, Greater Bay Joint Division, Shenyang National Laboratory for Materials Science, City University of Hong Kong Shenzhen Research Institute, China

• Hong Kong Branch of National Precious Metals Material Engineering Research Center (NPMM), Department of Mechanical Engineering/Department of Material Science and Engineering, City University of Hong Kong, China

November 14 (Tue.) 10:05-10:55 Room 301+302

Recent Development of Surface Modification: from Nanostructure to Supra-Nanostructure

To develop high efficient and advanced energy system, the creation of new materials and associated systems is one of the key directions. This presentation will feature recent development of structural nanomaterials and high performance functional nanomaterials for the potential applications in mechanical and energy systems. The mechanisms of nanomaterials processing with different nano-structures by high efficient physical methods will firstly be reported by illustrating our latest findings / research progress on the nanomaterials with high strength and high ductility, nanostructure materials with gradient structure, hierarchical nano-twinned materials, nanomaterials with multiphase embedded structure and the supra-nanostructured materials. We will also present our recent work on an approach that combines the strengthening benefits of nano-crystallinity with those of amorphization to produce a dual phase material that exhibits near-ideal strength at room temperature and without sample size effects. The feasibility of applying different nanomaterials on various catalysis for splitting water (HER), light-weight vehicle and energy systems such as robotics in challenging environment (nuclear plant), ocean exploration and thermal energy conversion will be discussed. The application of new nanomaterials on the newly designed light-weight automotive parts and the development and research direction of the biomimetic morphing and 3D printed nanostructured materials on advanced aerospace and underwater vehicles systems will be presented.

Reference:

[1] J.C.Ye, J.Lu, C.T.Liu, Q.Wang, Y.Yang, Atomistic Free-Volume Zones and Inelastic Deformation of Metallic-Glasses Characterized by High-Frequency Dynamic Micropillar Tests, Nature Materials, Volume 9, Issue 8, August 2010, pages 619-623.

[2] H.N.Kou, J.Lu, Y.Li, High-Strength and High-Ductility Nanostructured and Amorphous Metallic Materials, Advanced Materials, 2014, 26, p5518–5524

[4] Q.Wang, S.T.Zhang, Y.Yang, Y.D.Dong, C.T.Liu, J.Lu, Unusual fast secondary relaxation in metallic glass, Nature Communications, 24 Jul 2015, DOI: 10.1038/ncomms8876

[5] Y.F.Ye, Q.Wang, J.Lu, C.T.Liu, Y.Yang, High-entropy alloy: challenges and prospects, Materials Today, Volume: 19, Issue: 6, Pages: 349-362, July-August 2016

[6] G.Wu, K.C.Chan, L.L.Zhu, L.G.Sun, J.Lu, Dual-phase nanostructuring as a route to high strength magnesium alloys, Nature, 4th May 2017, Pages:80-83

[7] G.Liu, Y.Zhao, G.Wu, J.Lu, Origami and 4D printing of elastomer-derived ceramic structures, Science Advances, 17 August 2018；4：eaat0641, pp1-10

[8] F.Lyu, S.Zeng, Z.Jia, F.X.Ma, L.G.Sun, L.Cheng, J.Pan, Y.Bao, Z.Mao, Y.Bu, Y.Y.Li, J.Lu, Two-dimensional mineral hydrogel-derived single atoms-anchored heterostructures for ultrastable hydrogen evolution. Nature Communications, 13(1). 21 Oct 2022

[9] F.Q.Hao, B.Wang, X.Wang, T.Tang, Y.Li, Z.B.Yang, J.Lu, Soybean-inspired nanomaterial-based broadband piezoelectric energy harvester with local bistability. Nano Energy, 103, 107823. 1 Dec 2022

[10] S.D.Liu, H.K.Li, J.Zhong, K.Xu, G.Wu, C.Liu, B.B.Zhou, Y.Yan, L.X.Li, W.H.Cha, K.K.Chang, Y.Y.Li, J.Lu, A crystal glass–nanostructured Al-based electrocatalyst for hydrogen evolution reaction, Science Advances, Vol. 8, Issue 44, 4 Nov 2022,