Improving fatigue performance of additive manufactured metal structures by ultra-stable microstructures

Currently, additive manufacturing is a popular topic, while laser based additive manufacturing is the most applied technique for metal based additive manufacturing. Laser based additive manufacturing can be used to print complex, hard machining materials and large components. However, the major issue for laser based additive manufacturing is that it introduces thermal tensile stress, which will decrease fatigue life of metal components. Fatigue is responsible for 90% of metal failure. A two step manufacturing technology, including laser sintering plus laser shock peening (LSP), was proposed to improve fatigue life. First, 0D (Nanoparticles), 1D (carbon nanotube) and 2D (graphene or graphene oxide) nanomaterials were integrated into metal matrix by laser sintering. Then laser shock peening was performed to introduce high density of dislocations and novel microstructures. Compressive residual stress and surface work hardening will be also introduced by LSP. The interaction between dislocations with nanomaterials will help to block dislocation movement, thus stabilizing residual stress and work hardening. The stabilized work hardening and residual stress will increase the resistance for crack initiation and crack propagation, so that we can greatly improve fatigue life.

About the speaker: Dr. Lin is currently working with Prof. R. Byron Pipes and Prof. Gary J. Cheng as a Research Associate at Purdue University, West Lafayette. He served as a Lecturer during the Fall 2014 semester, for IE 370: Manufacturing Processing. Before that, he obtained his Ph.D. degree in Manufacturing Direction from the School of Industrial Engineering at Purdue University, West Lafayette, in August, 2013. He was awarded a Ross fellowship for his Ph.D. study, he also served as the Vice President of the Purdue University Chinese Students and Scholar's Association. He got his Master's degrees from the University of Nebraska-Lincoln and Hua Zhong University of Science and Technology, both in Mechanical Engineering, and a Bachelor's degree from Harbin Institute of Technology. His current research interest is additive manufacturing of multifunctional composites.