Laser shock nanoimprinting for shaped metals and low-dimensional materials

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Abstract
Metallic nanostructures have attracted tremendous interest in a variety of fields such as plasmonics, optoelectronics, and biosciences. The large-scale manufacture of these structures with high fidelity and quality represents a substantial challenge, due to the high cost and low throughput inherited in current top-down approaches, and poor reproducibility and quality of bottom-up methods. The precision of traditional laser-based manufacturing is limited by the spot size and wavelength. This talk will first present the development of a novel process based on laser-induced shock wave effect for ultrafast nanoshaping of metals and their multilayers with 10-nm precision. Comprehensive numerical models from atomistic to continuum levels are developed and combined with experimental techniques to understand the mechanism of the ultra-high strain-rate deformation. The mechanical and optical properties of the imprinted metallic nanoarrays are investigated with various techniques such as nanoindentation and Raman spectroscopy. Next, I will talk about the application of laser shock nanoimprint in exploring a new regime of nanomaterial deformation and developing top-down approaches for post-fabrication gap tuning of plasmonic nanostructures, elastic straining of brittle semiconductor nanowires and two-dimensional layered materials.

Bio Sketch
Dr. Yaowu Hu is currently working as a research associate at Purdue University. He received his Ph.D. degree in Manufacturing Direction from School of Industrial Engineering at Purdue University, West Lafayette in 2016, M. S. degree in Advanced Manufacturing from Institute of Mechanics, Chinese Academy of Sciences, Beijing in 2012, and B. S. degree in Engineering Mechanics (with first class honor) from Southeast University, Nanjing in 2009. His current research interests include laser-based/assisted advanced manufacturing, light-matter interaction and material deformation. His articles in Science (2014), Advanced Materials (2016) and Nano Letters (2016), have attracted significant interest in laser shock induced nanoshaping. Dr. Hu has authored/coauthored 20 journal articles in laser-based/assisted advanced manufacturing, including welding and selective sintering/melting processes, and is a co-inventor on 3 issued patents.