



## From Light to Lattice: Laser-Enabled Nanomanufacturing Across Scales

Gary Cheng

Industrial Engineering / Materials Engineering

Wednesday, Oct. 15<sup>th</sup> @ 2:00 pm in BRK 1001

*Coffee and snacks served before seminar*

also on [MS Teams](#)

**Abstract:** This seminar delves into the forefront of nanoscience and technology, spotlighting laser-induced transformations in manufacturing nanostructures and nanomaterials. The first dimension, 2D-2.5D Nano-Shaping, navigates through Laser Nano-Imprinting techniques, unraveling the intricacies of metal nanoshaping, 2D materials/metal metasurface fabrication, and plasmonic metamaterials. The exploration of nano-straining follows, with a focus on engineering strain in 2D materials, heterostructured 0D/1D/2D architectures, and interlayer strain coupling. Nano-lithography of functional materials unveils advanced methodologies like plasmonic nanoparticle-guided laser etching and plasma-photon interference lithography for liquid metals and metals. The journey extends into 3D Multiscale Printing, uncovering a new class of metamaterials, such as AI-guided mechanical metamaterials - Constant-Mean-Curvature Metamaterial (CMC-meta) for ultimate stiffness, toughness, and fatigue life. The laser-induced structure and property changes section further explores large-scale laser-induced phase changes/doping, and Laser Thermionic Synthesis of nano-alloys. Finally, the seminar illuminates large-scale nanomaterials synthesis techniques for energy and environment, including Laser Nanometallurgy of atomic metals and the direct writing of electrodes, showcasing applications like silicon-based anodes for Lithium-Ion batteries and nano-metal-based nano-catalyst. This talk will give comprehensive insights into the transformative power of laser-induced techniques, shaping the future landscape of nanomaterial engineering.

**Bio:** Gary Cheng is a Professor in School of Industrial Engineering and School of Materials Engineering, Purdue University since 2007. He graduated from Columbia University in 2002 with Ph.D. in Mechanical Engineering. He is elected fellow of AAAS, ASME, SME, RSC, RSA, and ISNM. His work involves novel manufacturing techniques to enable well-designed nanomaterials and nanostructure in structural component for superior mechanical properties, new metamaterials-design theory, and manufacturing technique in 3D nanoprinting, and nanoscale 3D manipulation of nanomaterial, for patterning, integration, and strain-engineering. These breakthrough applications have had wide-ranging impacts across industries, from semiconductors, quantum technology to aerospace, energy, environment, and biomedical. His research works in were published in more than 250 Journal articles, including Science, Nature Materials, Science Advances, Nature Communications, Advanced Materials, Nano Today, Materials Today. His research was highlighted in Nature Photonics, Nature Materials, and Nature Research Materials. He has been recognized by NSF CAREER Award, ONR Young Investigator Award, SME outstanding young manufacturing engineer, ASME Cho & Trigger Young Investigator Award, National Research Council senior research fellowship, ASME Milton C. Shaw Manufacturing Research Medal, and ASME Blackall Machine Tool and Gauge award.