

Title: Breaking the Resolution & Speed Limit – Next Generation Technology for Scalable Micro Additive Manufacturing

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Abstract:

Additive manufacturing printing, i.e., 3-D printing, is one of the most important technological innovations in the past few decades. Among the various techniques, two-photon polymerization (TPP) is the most precise 3-D printing process that has been used to create many complex structures for advanced photonic and nanoscale applications, e.g., microrobots, optical memories, metamaterials, photonic crystals, and bio-scaffolds etc. However, to date the technology still remains a laboratory tool due to its high operation cost and limited fabrication rate, i.e., serial laser scanning process. In this seminar, I will present our recent work on parallelization of the TPP process based on temporal focusing via a digital micromirror device (DMD), where programmable femtosecond light sheets are formed and used to substantially improve the rate without sacrificing resolution. We will demonstrate the fabrication of arbitrarily complex structures at a record-breaking resolution and speed, i.e., lateral/axial resolution: 140 nm/175 nm at 10s mm³/min, which is approximately 3 orders of magnitude higher than any existing fabrication methods. Our new method provides an effective and low-cost solution to scale-up the fabrication of functional micro- and nano-structures (~\$1.5/mm³). This means our technology may play a large role in fields such as healthcare, clean energy and water, computing, and telecommunications.

Biographical Sketch:

Dr. Shih-Chi Chen is a Professor in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. He received his B.S. degree in Mechanical Engineering from the National Tsing Hua University, Taiwan, in 1999; and his S.M. and Ph.D. degrees in Mechanical Engineering from the Massachusetts Institute of Technology, Cambridge, in 2003 and 2007, respectively. Following his graduate work, he entered a post-doctoral fellowship in the Wellman Center for Photomedicine, Harvard Medical School, where his research focused on biomedical optics and endomicroscopy. From 2009 to 2011, he was a Senior Scientist at Nano Terra, Inc., a start-up company founded by Prof. George Whitesides at Harvard University, to develop precision instruments for novel nanofabrication processes. His current research interests include ultrafast laser applications, biomedical optics, precision engineering, and nanomanufacturing. Dr. Chen is a member of the American Society for Precision Engineering (ASPE), American Society of Mechanical Engineers (ASME), SPIE, and the Optical Society (OSA); and currently serves as the Associate Editor of ASME Journal of Micro- and Nano-Manufacturing, IEEE Transactions on Nanotechnology, and HKIE Transactions. In 2003 and 2018, he received the prestigious R&D 100 Awards for developing a six-axis nanopositioner and an ultrafast nanoscale 3-D printer respectively.