Architectured Metamaterials: Harvesting Light, Tunable Sound Switches and Beyond

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Abstract:

Metamaterials are made of precisely fabricated constituents that are analogous to 'atoms' and 'molecules' in natural materials. These emerging class of metamaterials promise to fill the white space of material selection, giving enormous choice of unusual effective material parameters for different applications.

In the optical domain, we report our progress on enhancement of light harvesting and conversion in the micro/nanostructures, which promise for efficient light scattering and detection. As example, we will show our development of a thermochromic window which dynamically shields the solar-energy flux up to 76% at a low phase transition temperature. I will also introduce our ongoing efforts on broadband photo-absorbers, directional emitters for solid state lighting, as well as compact and power-efficient devices.

In the arena of micro/nanofabrication, I will also present our development of three dimensional micro/nanofabrication technique, projection microstereolithography (PuSL), to enable design and exploration of digitally coded multifunctional and multimaterial lightweight metamaterials that display unusual properties such as enhanced stretchability negative thermal expansion. The microscale resolution and multi-material capabilities of the 3D printing system and the modeling tools developed can be used to design and fabricate architected materials for applications such as novel acoustic absorbers and micro-scale bioreactors for tissue engineering.

Biosketch:
Nicholas X. Fang received his BS and MS in physics from Nanjing University, and his PhD in mechanical engineering from University of California Los Angeles. He arrived at MIT in Jan 2011 as Associate Professor of Mechanical Engineering. Prior to MIT, he worked as an assistant professor at the University of Illinois Urbana-Champaign. Professor Fang's areas of research look at nanophotonics and nanofabrication. His research on nanoarchitectured metamaterials was highlighted among the top 10 Emerging breakthrough technologies of the year 2015. His recognitions also include the ASME Chao and Trigger Young Manufacturing Engineer Award (2013); the ICO prize from the International Commission of Optics (2011); the NSF CAREER Award (2009) and MIT *Technology Review Magazine's* 35 Young Innovators Award (2008).