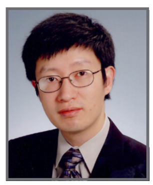
MITMECHE

Colloquium

Mechanical Engineering Lecture in Micro and Nanotechnology

Architectured Metamaterials: Harvesting Light, Tunable Sound Switches and Beyond



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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 looked into strong light confinement in optical coatings down to a few atom layers thick. We predict a new type of one-way edge magnetoplasmon at the interface of opposite magnetic domains, and demonstrate the existence of zero-frequency modes bounded at the peripheries of a hollow disk. These findings can be readily verified in experiment, and can also reveal a promising approach to engineer topologically robust chiral plasmonic devices. We also demonstrate experimentally ultrafast quenching of 2D molecular aggregates at picosecond timescale assisted by surface plasmons. Our results can offer novel design pathways to the light-matter interaction in a variety of photon-exciton systems with applications such as high speed visible light communication.

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.