Photonics Meets Mechanics: New Paradigms for Nanoscale Devices and Sensors

Ertuğrul Çubukcu
University of Pennsylvania

Light-matter interactions enable a number of technologies we use on a daily basis such as the internet and solid-state lighting. Therefore engineering the way light interacts with matter will lead to better and more efficient components and new technologies. Dr. Cubukcu's group studies resonantly enhanced light-matter interaction on the nanometer length scales. He utilizes this in combination with mechanics and emerging 2D materials for novel devices and sensors. In this talk, Dr. Cubukcu will give representative examples of these multifunctional devices. He will present a new type of a graphene enabled multimodal biosensor that can measure protein-protein interactions in the full opto-electro-mechanical domain. This biosensor combines all the advantages of the single mode sensors and achieves a 100 times improvement in the linear sensing dynamic range. Secondly, he will talk about optomechanically controlled frequency doubler based on a monolayer MoS2. His group achieves ~5000 times enhancement of second harmonic generation in a doubly resonant Fabry-Perot (FP) microcavity. Dr. Cubukcu will present his recent results on acoustic phonon lasing and cooling in an optical Fano resonance metamaterial. This is achieved by simultaneous phononic and photonic metamaterial resonances coupled through a thermoplasmonic backaction mechanism.