
Dr. Ertugrul Cubukcu
Assistant Professor, University of Pennsylvania

Abstract:
The concept of the antenna is widely used in the microwave regime and a key enabler in many applications including radio-frequency communications. However, its optical analog, namely, the nanoantenna is often overlooked. By simple scaling down of antennas, through “scale-invariance” of Maxwell’s equations and ignoring kinetic inductance, one gets an antenna for light that has nanoscale dimensions commensurate with the much shorter optical wavelengths. Although the physics is the same, nanoantennas enable unique functionality in the optical domain. In this talk, I will discuss the use of nanoantennas in the context of efficient infrared absorbers and nanoscale optical sensors. I will first introduce our results on nanoantenna enhanced thermoplasmonic mechanical infrared detectors with sub-nW level sensitivity, which can be used as single pixel detectors in integrated photoacoustic gas sensors. Next, I will talk about a graphene enabled opto-electro-mechanical biosensor that uniquely integrates a nanoelectronic graphene field effect transistor based sensor and a nanoantenna based optical sensor on a nanomechanical resonator based sensor. This multimodal biosensor combines all the advantages of the single mode sensors and achieves a 100 times improvement in the sensing dynamic range. Finally, I will talk about our results on strong light-matter interactions between semimetallic graphene nanoantennas and infrared-active molecular vibrational modes.

Speaker’s Biography:
Ertugrul Cubukcu received his B.S. and M.S. degrees both in physics from Bilkent University, Turkey and his Ph.D. degree in applied physics from Harvard University. Following his postdoctoral work at the University of California, Berkeley, he joined the faculty at the University of Pennsylvania in 2011, where he is currently an assistant professor of Material Science and Engineering and, by courtesy, Electrical and Systems Engineering.
He is the author or coauthor of over 50 journal and conference papers, which have been referenced over 2300 times. His group explores the nanoscale opto-electro-mechanical devices and sensors that utilize unique features of nanoantennas and two-dimensional materials. His work has been featured in Optics and Photonics News, MIT Technology Review, Newsweek, Nature Photonics, and Laser Focus World.

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