Metamaterials: Bringing back the magic

Durdu Guney, PhD
Assistant Professor
Electrical and Computer Engineering
Michigan Technological University

Abstract: The field of electromagnetic metamaterials has provided us with a new look at the materials by mimicking nature through engineering in subwavelength scales. This has led to the possibility of previously unthought-of applications such as flat lens, perfect lens, hyperlens, ultimate illusion optics, perfect absorber, quantum levitation, and many others. It is envisioned that control on electromagnetic properties of materials will transform the way we design electromagnetic devices in the entire spectrum, ranging from radio to ultraviolet frequencies. However, despite tremendous progress in theory and experimental realizations there are major challenges delaying the true optical metamaterial era to come. Perhaps, the most critical of all the challenges is how to avoid ohmic losses in metamaterial devices. Many of the proposed optical devices dramatically degrade and become useless due to significant ohmic losses arising from the metallic constituents of the metamaterials.

In this talk we will first summarize our efforts to advance the metamaterials and then give a special emphasis to the “loss challenge.” We will introduce a novel loss compensation scheme, which we call plasmon injection (Π) scheme. The Π scheme has important potential to revive the early magical dreams of the metamaterials by enabling the practical realization of diffraction unlimited flat lens known as perfect lens, which has been so far proposed among the most fascinating applications of metamaterials. A viable perfect lens technology could turn a smartphone into an imaging device with a functionality of unprecedented optical resolution equivalent to that of a million-dollar electron microscope.

Biography: Durdu Guney is an assistant professor in the Department of Electrical and Computer Engineering at Michigan Technological University. Prior to Michigan Tech he was a postdoctoral fellow in the US Department of Energy’s Ames Laboratory and Iowa State University. He received his PhD in Electrical and Computer Engineering (Applied Physics) from the University of California, San Diego in 2007. He performed consulting on an all-optical cryptosystem developed by Ziva Corp., San Diego in 2004. Prof. Guney is a recipient of 2012 Ralph E. Powe Junior Faculty Enhancement Award given by the Oak Ridge Associated Universities. His research interests include metamaterials, plasmonics, solar cells, quantum computing, communications and cryptography, photonic crystals and fibers, acoustic bandgap materials, and microoptoelectromechanical systems. Current research activities of Prof. Guney include diffraction-unlimited metamaterial flat lens, plasmonic solar photovoltaic cells, and quantum manipulation of light with metamaterials. He is an Associate Editor for Nanomaterials and Nanotechnology and a member of OSA, SPIE, IEEE, and MRS.