

Metamaterials: New Toys of Electromagnetism

Kaan Güven

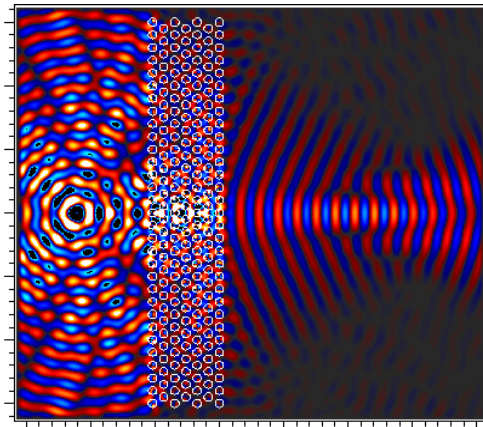
Nanotechnology Research Center and Department of Physics
Bilkent University

Metamaterial (or **meta material**) : [Wikipedia] is a material which gains its (unusual) properties from its structure rather than directly from its composition.

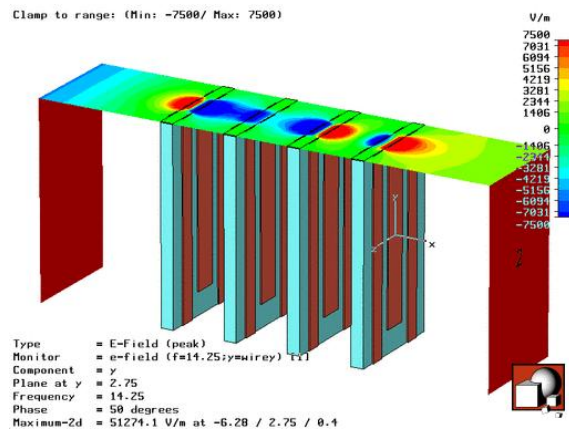
In electromagnetism, metamaterials are artificially constructed dielectric or metallic structures that act as an effective medium to the electromagnetic field propagating inside, and respond with tailored permittivity and permeability functions.

Metamaterials are envisaged as a new era of electromagnetism where intriguing electromagnetic phenomena can be realized that have never been observed in nature before. This fact coins their name *metamaterials*: materials *beyond* the (ordinary) materials.

This talk aims to provide a concise (but by no means complete) review on metamaterial research, with a particular view of the studies ongoing in Bilkent University. The metamaterial concept will be introduced briefly, and the composite metamaterials having negative index of refraction will be presented. The rest of the talk is a showcase of novel electromagnetic phenomena observed in metamaterials such as, negative refraction, negative phase velocity, focusing by planar superlenses. Finally, the highly acclaimed “electromagnetic cloaking” phenomenon will be discussed, which is based on conformal mapping metamaterials.



Focusing by photonic crystal metamaterial flat lens [K. Guven et al. Phys. Rev. B **70**, 205125 (2004)]



Electromagnetic wave propagation through metal paired cutwire and wire based composite metamaterial with negative index of refraction [K. Guven et al. Optics Express **14**, 8685 (2006)]