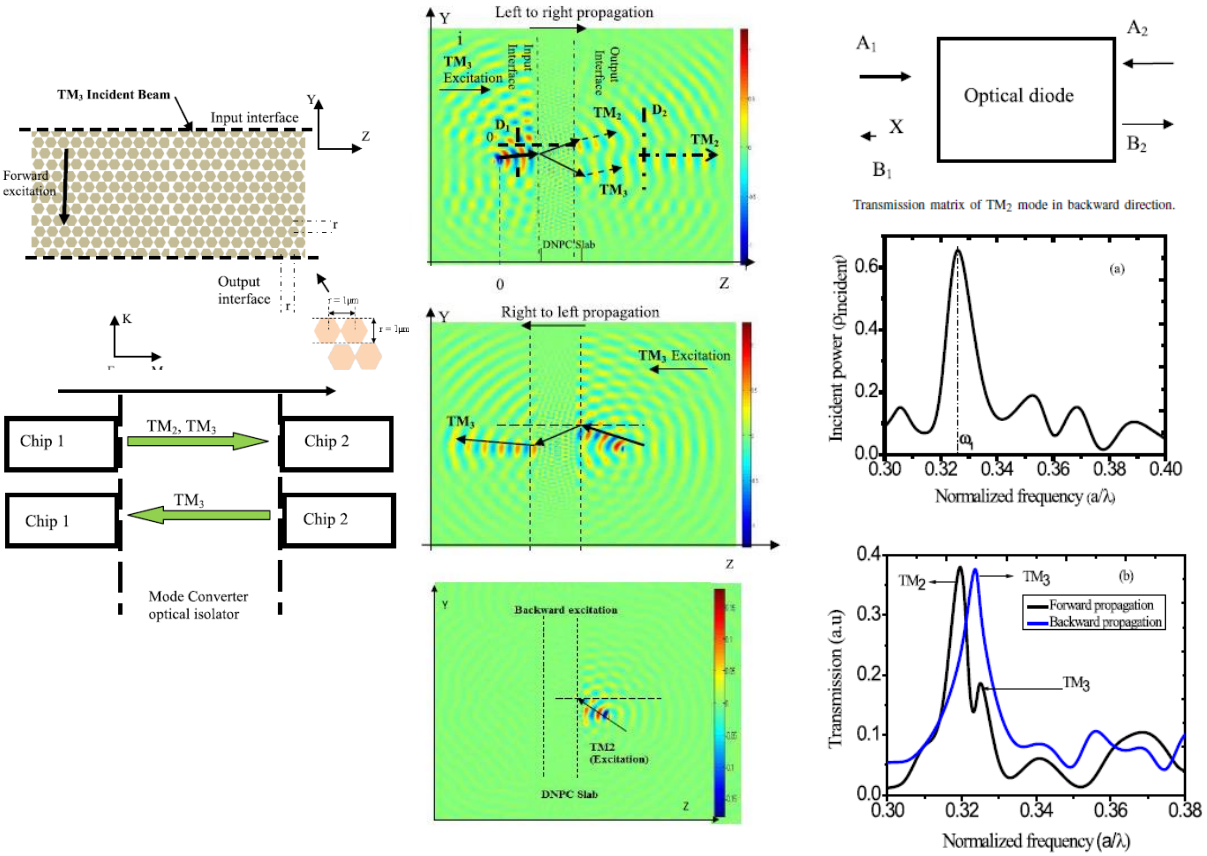
Metamaterial Based Devices based on Photonic Crystal Structures

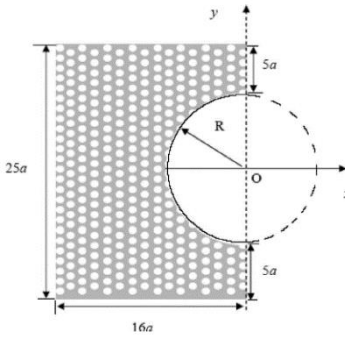
Artificial metamaterials, known as man-made Metamaterials, or so-called left-handed (LHM) materials, are materials with both a negative dielectric permittivity and a negative magnetic permeability. These materials have properties not found in nature. One of the most advanced opportunities for metamaterials is the development of negative-index materials. As a result of this, bringing the refractive index into a new domain of negative refraction has excited the imagination of many researchers around the world that are now studying different aspects of these materials operating at optical and microwave frequencies.

We have extensive expertise on developing and deploying 2D and 3D FDTD for designing various metamaterial devices and systems based on Photonic Crystal Structures. Below is a list of some Metamaterial devices that our group has designed:

1) Optical Isolator Based on Dual Negative Refraction Photonic Crystal



2) Concave Lens Based on 2D Photonic Crystals With a Negative Refractive Index.



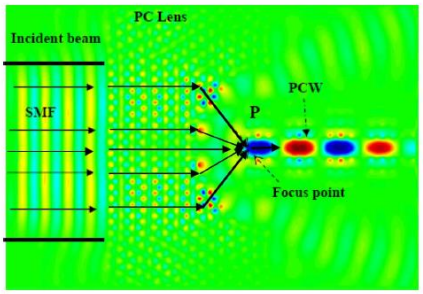


Fig. Evolution of the electric field from the SMF to the PCW at the frequency $f = 0.315\ a/\lambda$.

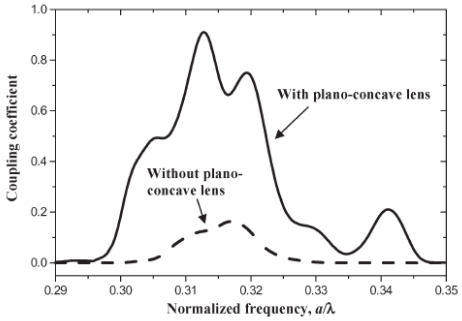
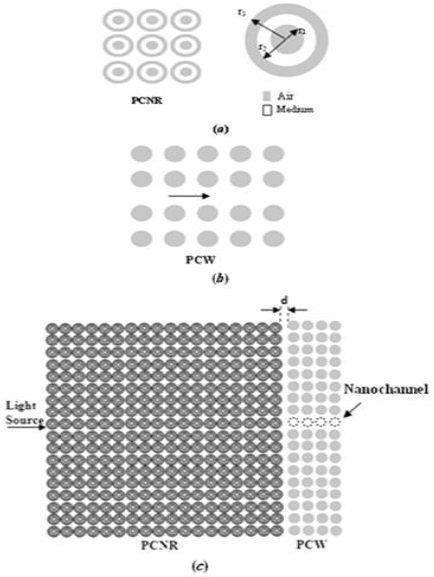
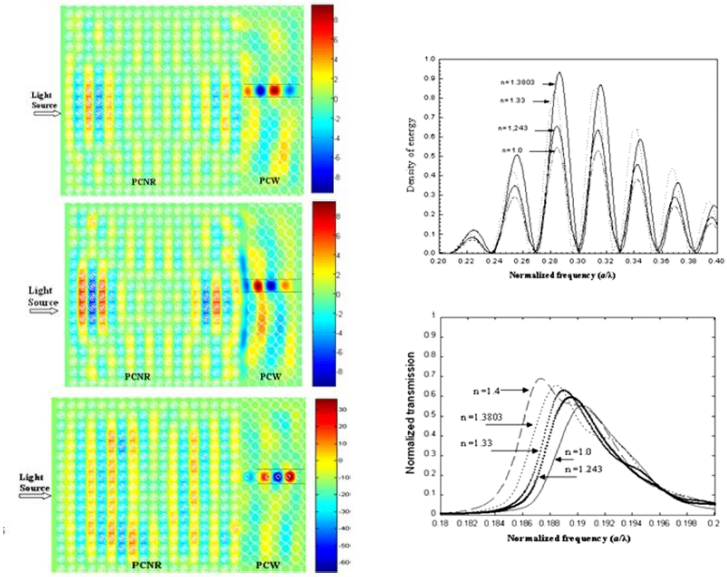


Fig. Variation of the coupling efficiency as a function of the normalized frequency with and without incorporation of the planoconcave lens between PCW and SMF.

3) Nanophotonic Sensor Based on Photonic Crystals Using Negative Refraction



Photonic Crystal with Negative Refraction Nanosensor



Nanochannel (sensor) is filled with different analyte

4) Metamaterial Photonic-Crystal-Based Chemical Sensors

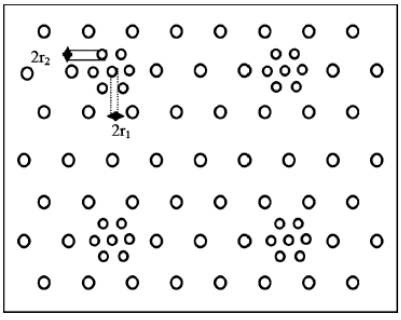
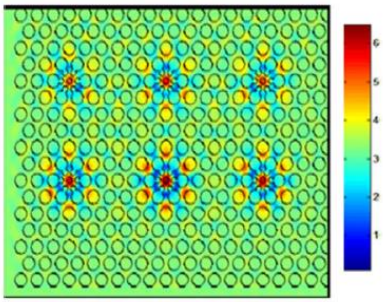
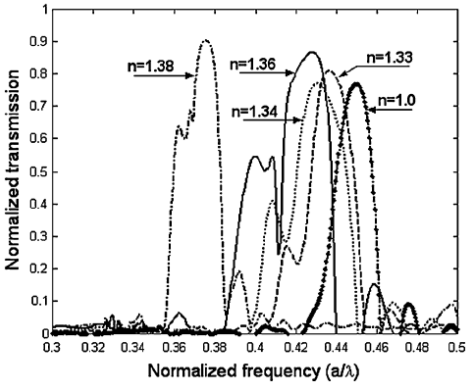


Fig. 1. PCNR with multicavity regions platform-based sensor.





Transmission variation with frequency for various refractive indices of molecules.