THz refractive index sensor using split ring resonator

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THz range of frequency has found increasingly wide range of applications in material characterization, sensing, imaging and extreme bandwidth communication. This is mainly due to the fact that many important materials have specific signatures over these frequencies. In recent years, many groups have used meta-materials for many different applications at microwave and THz and optical frequencies. In many cases the building block in the meta-material structure is split ring resonator which is a metal loop consisting of a single cut.

Here we consider a two dimensional array of split ring resonators as a THz refractive index sensor. The resonance frequency, at which there is a minimum in the transmission, is sensitive to the material around the structure and therefore it can be used as refractive index sensor. Lumerical FDTD solver has been used to design single SRR which has resonance at THz frequency. Scattering cross section of the SRR has been calculated and shows a peak at the resonance frequency. Then, using Floquet mode in HFSS and periodic boundary condensations, an array of SRR has been analyzed. Reflection and transmission through the structure under normal incidence have been calculated as the functions of frequency. An effective frequency dependent dielectric model for the structure has been presented using these functions. Using a thin layer sample, transmission and reflection of the sensor have been presented for several different samples. Sensitivity of the sensor to the refractive index of the sample has been calculated.