# Result Analysis of an Electromagnetic Absorber

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## ABSTRACT

*An absorber has been designed for narrow-band terahertz absorber with strong absorption at frequencies 110 THz. Both incident waves with TE and TM polarisation are insensitive to the absorber. By examining the electrical field density, it was determined that the dipolar and hexapolar resonances are the physical causes of the features displayed by this absorber. Additionally, the effects of the primary structural designs and factors on the absorption frequencies were investigated. The absorption frequencies may be changed to higher or lower values by adjusting a number of structural elements, such as cross length and dielectric thickness. By changing the structural arrangements, it is also possible to change the absorption frequencies and the total number of resonance bands.*

***Keywords***: THz, MTM, Metamaterial, Absorber.

## INTRODUCTION

Electromagnetic perfect absorbers, in particular, have been investigated for a long time, for various applications. In an electromagnetic absorber, reflected and transmitted power are minimized, and for most cases, the incident light turns into heat, which could also be further used to harvest energy in another energy domain. Unlike other metamaterial-enabled devices where losses are generally to be avoided, metamaterial absorbers take advantage of such loss, which mainly arises from a finite resistivity of metal or dielectric loss in the system. The metamaterial absorbers, if designed properly, can be applied in almost all electromagnetic regime, including radio frequency (RF) and microwave, THz, infrared and visible.

As mentioned above, metamaterial absorbers of diverse kinds have been explored to achieve high absorption in wide electromagnetic spectrum from RF to visible. One of the differences when designing metamaterial absorbers at different frequency regimes is the origin of loss that dominates the absorption. For instance, the earlier demonstration of metamaterial absorbers exploits dielectric loss associated in the split ring resonators and a cut wire separated by a dielectric layer to achieve 88% absorption at 11.5 GHz. On the other hand, at higher frequency regime, Ohmic loss from metal layers start to dominate. While the microwave absorbers are mainly used in RF wireless communication applications, the higher frequency regime in THz, IR, and visible range can be useful for imaging and sensing applications. Since the size of the metamaterial structures are largely dependent on the operation wavelengths, the fabrication techniques also depend on the working spectral range. For instance, standard optical lithography techniques on a printed circuit board or a wafer-level substate can be used for metamaterials in low frequency regime, as the critical dimension of the standard optical lithography is much smaller in micro and nanometre scale.

However, this prevents the use of conventional photolithography techniques to fabricate electromagnetic absorbers in higher frequency regime such as IR or visible. Recently, the advancement of nanofabrication techniques such as electron beam lithography and nano-imprinting techniques allow for the fabrication of sub-micron scale metamaterial absorbers in IR and visible regimes.

## PROBLEM STATEMENT

A metamaterial absorber should have crucial properties such as angular response and polarization sensitivity depending on the usage. For example, polarization-dependent absorption and tiny acceptance angles are typical characteristics of metamaterial reflectors based on counter plasmons, which can be exploited for sensing applications. On the other hand, it is possible to significantly increase the absorption efficiency by using a broad acceptance angle and polarization insensitivity. specifically for non-invasive standoff chemical electrochemical sensors, where the chemical is inherently spread over a wide field of view with random orientations of molecular structures, resulting in stochastic incident angles and polarizations, both the acceptance angle and polarization sensitivity of the dampers play an important role in maximizing the total absorption.

## IMPLEMENTATION

In order to calculate the absorption properties of the absorbers, the following equation is used:

$$A(\omega) = 1 - R(\omega) - T(\omega)$$

This work focuses on the formulation of the problem based on the inferences drawn out of literature survey. The fill the existing research gaps an attempt has been made here in this research work and a problem has been formulated on the basis of analysis carried out on the previous works reported so far in the literature. A solution has been proposed and reported with result analysis in this work. The problem here is to investigate and design the narrow-band metamaterial absorbers for the infrared frequency spectrum. In this chapter, we studied and analysed the effects of narrow band metamaterial absorbers for Infrared Frequencies. It is suggested to use a fresh, straightforward design for the top layer based on the most typical shape, the circular one. The absorption band may be narrowed based on our theoretical investigation of adjusting the symmetry and homogeneity of the metallic micron circular disc on top. The MIM-based absorber is projected to produce a small absorption peak with some widened absorption bandwidth by modifying the r shape to a circular form. The top layer may be constructed using a periodic arrangement of unit cells comprising circular discs of various sizes to create even broader spectra, we discovered later. This results in a larger bandwidth of greater than 50% absorbance between 2.80 m and 3.90 m.

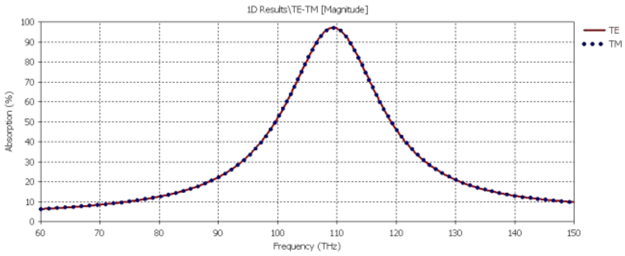


**Figure 1:** Absorption Spectra for TE and TM Polarization

## RESULTS & DISCUSSION

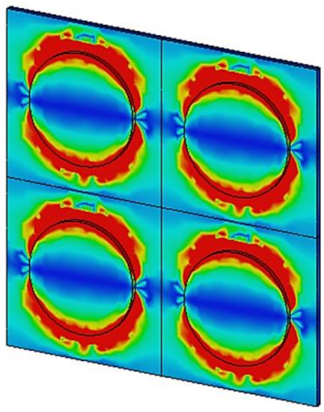

**Figure-2**: Electric Field Distribution

The electrostatic current (|E| and real |Ez|) spectra for the planned absorber at the previously discovered absorption peak are shown in Figures 3.5 and 3.6 (110 THz). The electric field |E| is notably cantered on the ascending and descending baselines of the circular ring construction for port 1 in mode f=110 THz. So, an overall conclusion can be derived from the electric field analysis that at the resonant frequency most of the electric field with high intensity are located near the circular metal disk only. Therefore, the metal disk can be considered as the resonator in the proposed trilayered structure. The electric field distributions clearly display the excitation of an electric dipole resonance at the resonant wavelength.

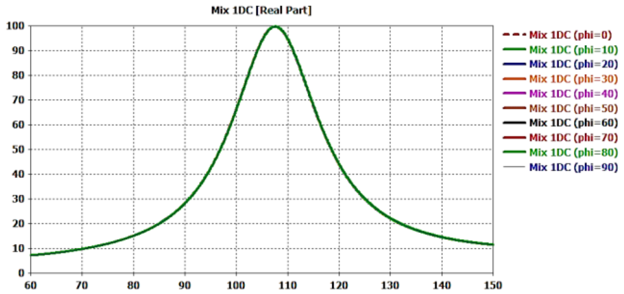


**Figure 3:** Polarization Plot for different Angles

## CONCLUSION

The research work carried out here is to design a single band metamaterial absorber functioning in infrared regime. The novel structure is based on simple circular shape resonator and has not been proposed before. By combining multiple sized resonators on the top layer, a single band absorption in infrared regime can be realized. A structure that can create single absorption band in the terahertz regime is also suggested in order to construct an adjustable high-absorption multiple bands metamaterial absorber that will be useful in many engineering sectors, such as detecting and terahertz imaging.

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