

## Modulating Plasmon Induced Transparency in Terahertz Metamaterials

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**Abstract :** Research in metamaterials has been gaining momentum over the past decade owing to its ability in controlling electromagnetic wave properties through careful design at the sub-wavelength scale. The metamaterials have led to several important phenomena which are useful in a variety of applications. One such phenomenon is the electromagnetically induced transparency (EIT) effect in which a narrow transparency region is created in an otherwise absorptive spectrum. In our work, we explore plasmon induced transparency (PIT) in terahertz metamaterials which is analogous to EIT effect. The PIT effect is achieved using the plasmonic metamaterials in which a unit cell is comprised of two C (2C) shaped resonators and a cut-wire (CW). When terahertz wave of a particular polarization is normally incident on the proposed metamaterials geometry, it strongly couples with the cut wire, resulting in the excitation of the bright mode. However due to the specific polarization of the incident beam, the fundamental modes of the C-shaped resonators are not excited by the incident terahertz, hence they are termed as the dark mode. The PIT effect occurs as a result of interference between the bright and the dark mode. In order to observe PIT effect, both the bright and dark modes should have similar resonant frequencies with a little deviation. We further have examined that the PIT window can be modulated by displacing the C-shaped resonators w.r.t. the cut-wire. The numerical observations for different coupling configurations can be explained through an equivalent lumped element circuit model. Moving ahead the PIT effect is further explored in a metamaterial comprising of a cross like structure and four C-shaped resonators. For such configuration, equally strong PIT effect is observed for two orthogonally polarized lights. Therefore, such metamaterials demonstrate a polarization independent PIT response w.r.t the incident terahertz radiation. The proposed study could be significant in the development of slow light devices and polarization independent sensing applications.

**Keywords :** terahertz, metamaterial, split ring resonator, plasmon

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