PLASMONIC METAMATERIALS

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Plasmonic metamaterials are artificially designed materials with unprecedented electromagnetic properties. By engineering such materials, we can control the magnetic permeability even in the optical frequency region in which all materials in nature lose magnetic response and the relative permeability of the materials are fixed unity. We have theoretically investigated the magnetic response of plasmonic metamaterials in the optical frequency region. Results are shown in Fig. 1. From these results we have clarified that three-dimensional array of split-ring-resonators made of silver can give a strong magnetic response at the visible light frequency region [1, 2]. The magnetic response at the light frequency region enables us to observe photonic phenomena never seen in natural substances. One example of these unprecedented photonic phenomena is Brewster effect in s-polarized light. Recently we found that the Brewster condition is satisfied even with s-polarized light at the interface between the materials that have different permeability [3]. By using this phenomenon and introducing the anisotropic metamaterial structure shown in Fig. 2, we proposed a novel non-polarizing Brewster device that transmits the light beyond the material boundary without any light reflection. Figure 3 is an example of non-polarizing Brewster device that can transmit light between vacuum (ε=1.0, μ=1.0) and glass (ε=2.25, μ=1.0) without loss. By inserting this novel Brewster prism made of metamaterial between vacuum and glass, the light can be transmitted from vacuum to glass without any surface reflection independently of its polarization. This mechanism can be applicable for new optical couplers of optical communication systems. In this presentation, we will also present the fabrication techniques of the metamaterials [4, 5].

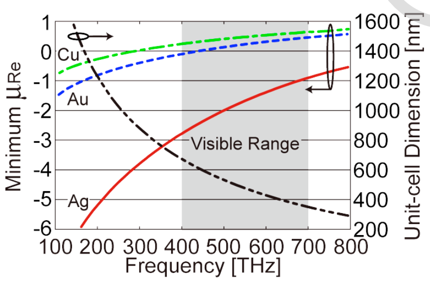

Fig. 1 Magnetic response of SRR

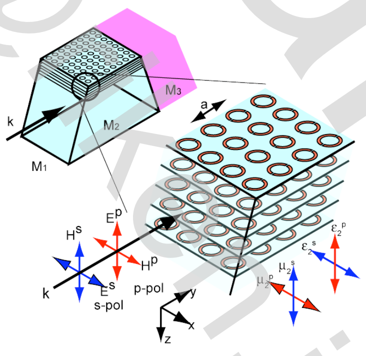

Fig. 2 Anisotropic metamaterial

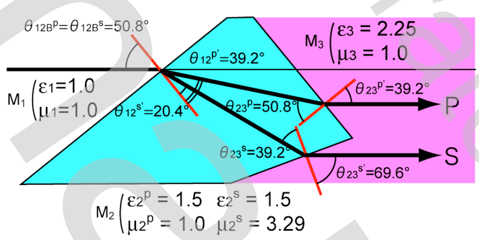

Fig. 3 Non-polarizing Brewster Device

References

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