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Implementation of Split Ring Resonators Instead Of Photovoltaic Cells in Solar Panels

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Abstract-This paper focuses on implementation of split ring resonators instead of conventional Photo voltaic cells in solar panels. Split Ring resonators are artificially produced structure common to metamaterials. This purpose is to produce the desired magnetic susceptibility (magnetic response) in various types of metamaterials up to 200 terahertz.

I. INTRODUCTION

Solar panels commercially used consist of photovoltaic cells. Solar modules use light energy from the sun to generate electricity through photovoltaic effect. The efficiency of the module determines the area of the module given the same rated output- an 8%efficient 230W. Instead of the usual photovoltaic cells, Split Ring resonators can replace them. As mentioned, Split Ring resonators are artificially produced structure common to metamaterials. A single cell SRR has a pair of enclosed loops with splits at opposite ends. The loops are made of non-magnetic metals like copper and have a small gap between them. The loops can be of any shape such a concentric, square and gapped as needed. (Fig. 1)

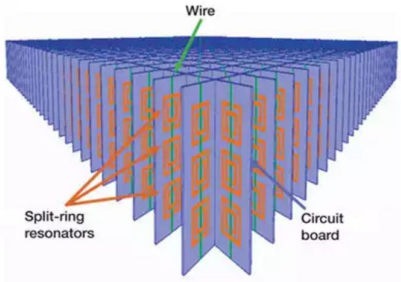


Fig (1)

II. METAMATERIALS

Metamaterials are artificial materials engineered to have properties that have not been found in nature, these materials are usually constructed into repeating patterns, often with microscopic structures as shown in Fig (2). They derive their properties from the exactly designed structures and not from compositional properties of base materials. Their size, shape, orientation, and arrangement can affect waves of light. The applications of metamaterials are diverse and include lenses for high gain antennas, smart solar power management, public safety, high- frequency battlefield communication, remote aerospace applications, sensor detection, and infrastructure monitoring and improving ultrasonic sensors.

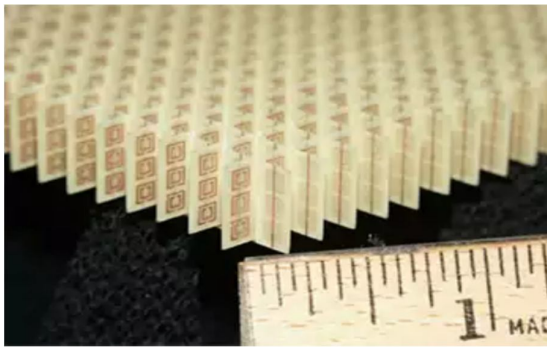


Fig (2)

III. ELECTOMAGNETIC METAMATERIALS

Electromagnetic metamaterials are materials comprised of structures whose electromagnetic properties are deliberately engineered to offer a range of response difficult or impossible to achieve in naturally occurring materials or composites. A remarkable aspect on one particular class of metamaterials is the ability to achieve magnetic permeability in a structured medium comprised of conducting non-magnetic elements. This attribute has facilitated creation of artificial magnetic materials at high frequencies. Resonant response of such a medium termed the Left handed behavior has been demonstrated at microwave frequencies and a terahertz (far infrared) as shown in Fig. 4.

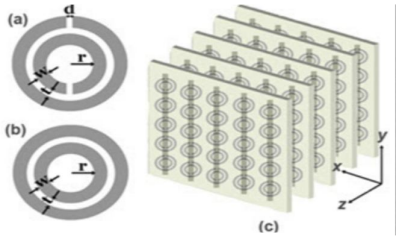


Fig (3)

IV. WHY SPLIT RING RESONATORS?

The split ring resonator and the metamaterial itself are composite materials. Each SRR has an individual tailored response to the electromagnetic field as in Fig (3). However, the periodic constructions of many SRR cells are such that the electromagnetic wave interacts as if these were homogenous materials. This is similar to how light actually interacts with everyday materials, an averaging or macroscopic effect is produced. The SRRs designed to mimic the magnetic response atoms only on a larger scale Also, as part of periodic composite structure there are designed to have a stronger magnetic coupling than found in nature. The larger scale allows more control over the magnetic response, whole each unit is smaller than the radiated electromagnetic wave.SRRs are much more active than ferromagnetic materials found in nature.

The pronounced magnetic response in such lightweight materials demonstrates an advantage over heavier, naturally occurring materials. Each unit can be designed to have its own magnetic response. The response can be enhanced or lessened as desired; In addition, the overall effect reduces power requirements.

V. SRR ON SOLAR PANELS

The solar energy is form of Infrared and electromagnetic radiations, which are made to fall on the split ring resonator units connected in a series package. The incident electromagnetic radiations produce a magnetic flux. The magnetic flux penetrating the metal rings will induce rotating currents in the rings, which produce their own flux to enhance or oppose the incident field depending upon the SRRs resonant properties. Due to splits in the rings, the structure can support resonant wavelengths much larger than the diameter of the rings. The small gaps between the rings produces large capacitance values, which lower the resonant frequency. This results in low radiative losses and very high quality factors.

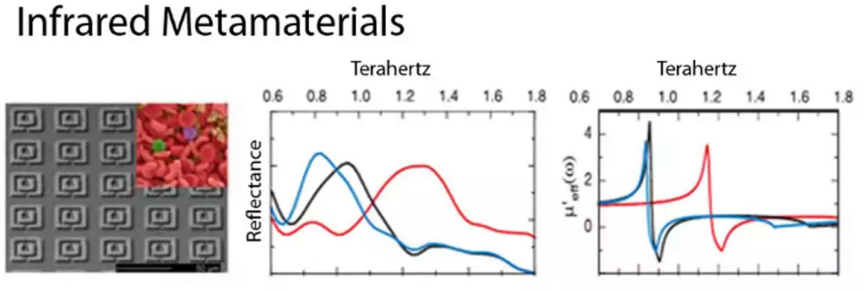
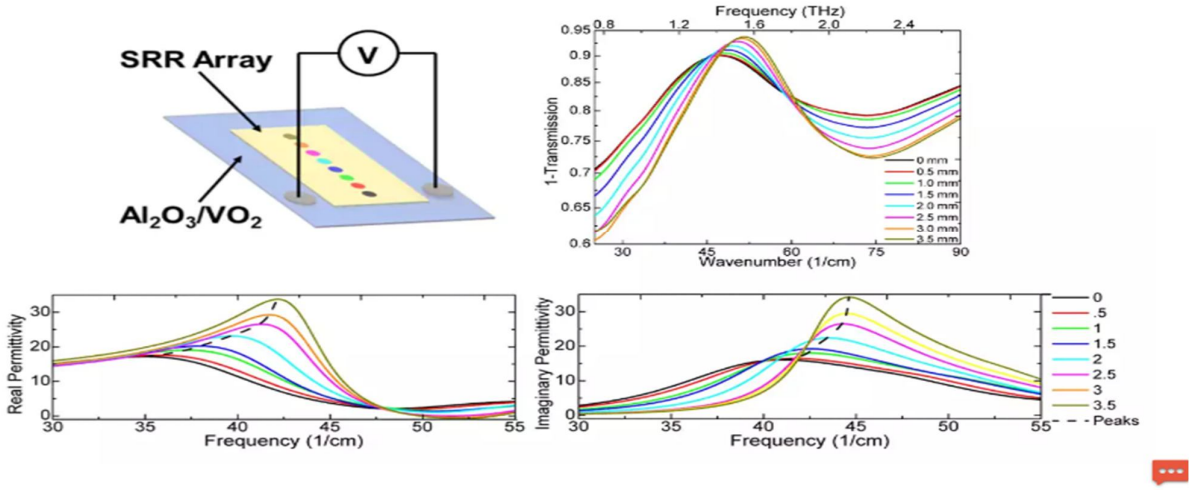


Fig (4)

VI. ADVANTAGES

The efficiency of using SRR is much greater than the commercials PV solar panels.
Increased Quality factor.
Reduced radiative losses.

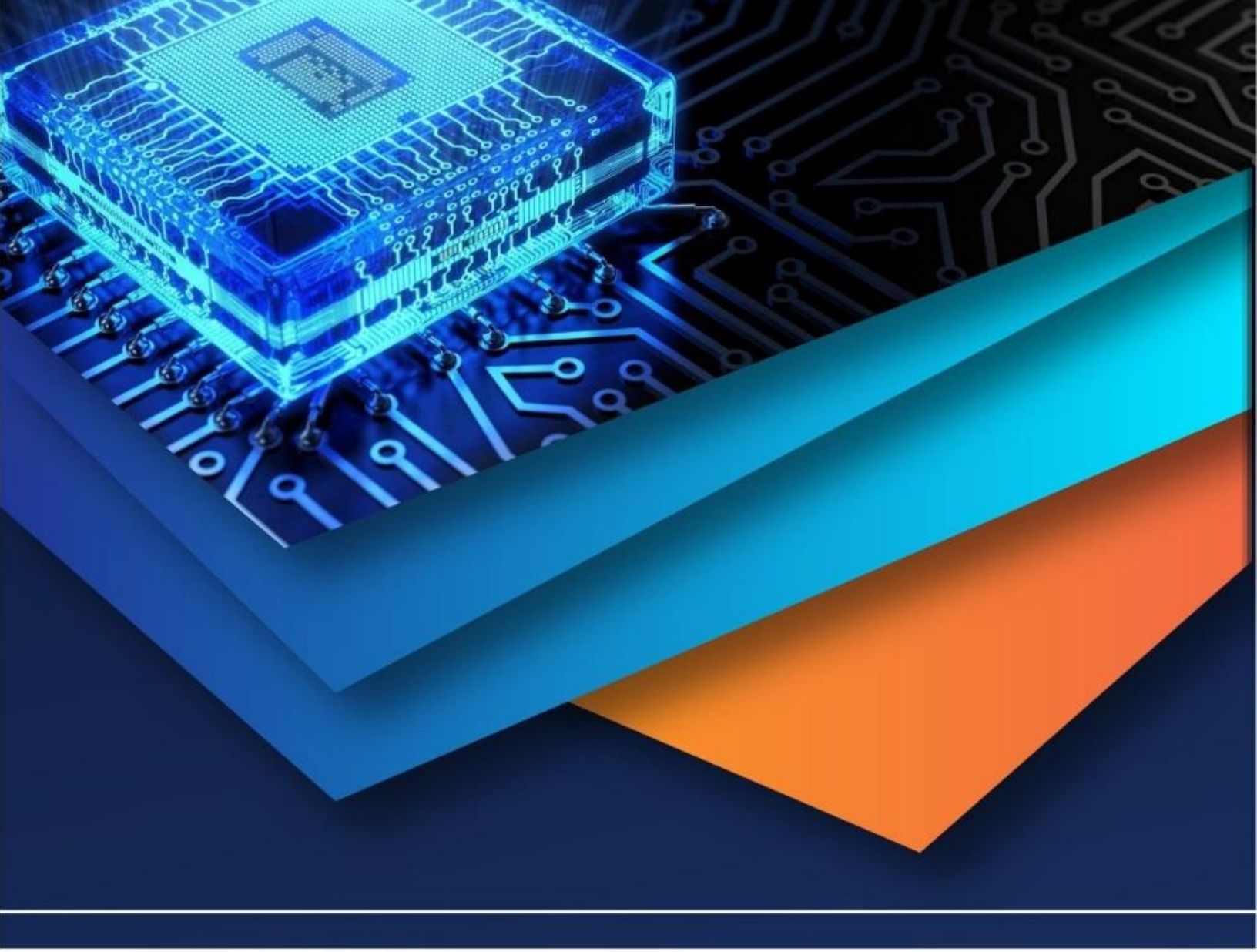


VII. CONCLUSION

Thus, the implementation of split ring resonators in solar panels instead of commercial photovoltaic cells provides a more efficient power generation. The future of power generation will depend only on the solar energy and this would certainly play a remarkable role in the solar power generation.

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