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ALIPHATIC ORGANIC COMPOUNDS : A SUBSTITUTE OF FERRITE MATERIALS IN ISOLATOR FOR HIGH FREQUENCY APPLICATION

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ABSTRACT:

Frequency instability of source oscillator is one of the major hurdles in microwave generator for example : klystron, magnetron, etc. one of the primary source of such instability is the reflection from the load side that highly affects the generating frequency.[10] isolators are the unanimous solution for such problems. Since the energy of the reflected wave resulting from load mismatch are dominantly absorb by the isolator that prevent the frequency instability in the source generator. Till date ferrites have been employed as the fundamental material in isolator.[10] the operation of ferrite isolator rely on the principal that when a circularly polarized wave is made to pass through a ferrite rod, which has been influence by an axial magnetic field, the axis of polarization gets tilted in clockwise direction and the amount tilt depends upon the strength of magnetic field and geometry of the ferrite. Some recent findings do suggest that aliphatic organic compounds are capable of exhibiting faradays rotation.[12] faradays rotation is mainly dependent on verdant constant and novel materials are required to obtain optimized verdant constant for tailor made high frequency application. This article highlight the feasibility and applicability of aliphatic organic compound in isolator applications the aim is to attract the technical interest towards employment of optimized organic materials for obtaining requisite verdant constant required for faradays rotation.

1. INTRODUCTION

Faraday rotation is the rotation of the plane of polarization of light which is due to magnetically induced circular birefringence. [1] It is important for optical isolators [2], magnetic field sensors [3], current sensors [4] , displacement sensors [5], integrated communication optics [6], detection of biomagnetic fields [7] and many others. It can be described by

$$\theta = VBL$$

where θ is the polarization rotation, V is the Verdet constant, B is the magnetic field parallel to the propagation of light, and L is the length of propagation through the magnetic field.

Isolators are invariably used to improve the frequency stability of microwave generators such as klystron and magnetron. Ferrites are used unanimously as the main material in isolators which works on principle of faradays rotation "the operation of ferrite isolator rely on the principal that when a circularly polarized wave is made to pass through a ferrite rod, which has been influence by an axial magnetic field, the axis of polarization gets tilted in clockwise direction and the amount tilt depends upon the strength of magnetic field and geometry of the ferrite". Isolators are used where the reflection from the load affects the generating frequency. In such cases, the isolator is placed between microwave generator and load with very small attenuation. Also energy of the reflected waves, resulting load mismatch is highly absorbed by the isolator. [10]

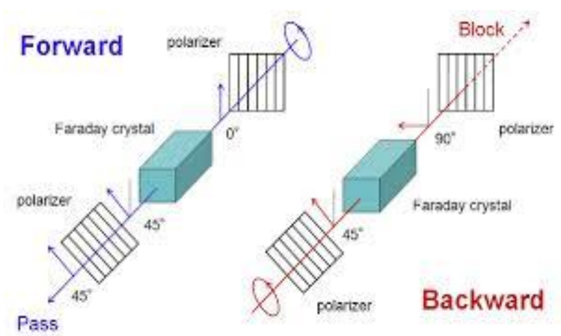

Fig. 1 *Forward and backward wave in isolator.*

Organic materials, although have shown their potential in various aspects of technology. They have been rarely consider for high frequency

application. Organic materials are advantageous due to their ease of synthesis, flexibility, processibility and compatibility with the natural substances.
The Verdet constant is a wavelength dependent material parameter. Typical Verdet constant of material currently use, iron oxide films [8] or substituted iron garnet films can reach millions of degrees per tesla per meter in the visible frequency region.The molecular Verdet constant is derived from Verdet constant in the liquid phase using numerical density of the liquid calculated from the molar mass and density from CRC handbook of chemistry and physics.

$$V_{molecular} \quad = n\, V_{liquid}$$

Among the various class of organic compounds, aliphatic organic compounds are having high potential for specialize application like faraday rotation.

2. LITERATURE SURVEY

Aliphatic organic compounds are also exhibiting faradays rotation. In that pioneer report Stefaan Vandendriessche have found faraday rotation and its dispersion.
This faraday rotation and dispersion have been measured and calculated in the 400 to 800 nm wavelength range. It is observed for a set of organic liquids. As per report, comparisons are made to both the polarizability and diamagnetic susceptibility, the resulting verdet constant are fitted and trends analyzed. The data are applied to a connectivity index model, allowing prediction of Verdet constants of aliphatic organic liquids from 400 to 800 nm reported by Ventsislav K. Valev. The observed correlations and connectivity model improve the understanding of Faraday rotation in diamagnetic materials, allowing for future optimization. [11]

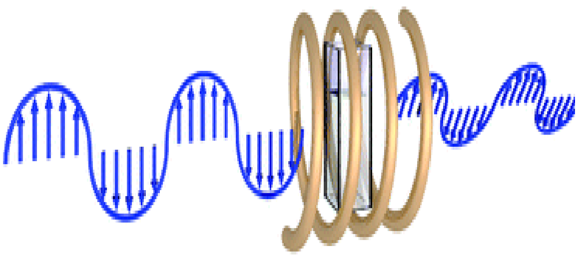

Fig. 2 *faraday rotation in aliphatic organic compound.*

A Verdet constant of almost 2.5×10^5 deg T^{-1} m^{-1} is found around 520 nm. This Verdet constant is 3 orders of magnitude larger than the largest known for organic molecules in a region without spectral features. This enormous Faraday rotation to resonant enhancement by a triplet excitation that does not appear in the linear absorption spectrum and to near-resonant enhancement by low-energy singlet excitations. Furthermore, Faraday rotation is able to switch by changing the liquid crystal phase of the compound. These results demonstrate a new class of Faraday rotating materials with great potential to replace current materials and improve existing applications. The inherent flexibility in the synthesis of this class of molecules opens a new field of research in Faraday rotation. [12]

3.PROSPECTIVE APPLICATIONS

Since the aliphatic organic compound are capable of showing faraday rotation. They may be exploited for future generation isolators. Some of the major applications have been found regarding faradays rotation of aliphatic organic compounds
Organic, diamagnetic materials in contrast saturate at far larger magnetic fields and additionally are relatively insensitive to temperature changes, which is beneficial for sensing applications. [9]
An additional advantage of organic materials over inorganic garnets for Faraday rotation is their processability and flexibility [9]. Faradays rotation is able to switch by changing the particular phase of the compound. [12]
In addition, strong Faraday rotation is observed below 450 nm due to resonant enhancement by absorption at these wavelengths. [12]
The observed concentration and connectivity model improves the understanding of faradays rotation in diamagnetic materials allowing the future optimization.
This make them an important candidate for future application.
However, no research have been initiate in this direction till date.

4. CONCLUSIONS

Aliphatic organic compounds are able to show faradays rotation.
This can be useful material in isolator for high frequency.
Till date, ferrite is used as important material in isolator for microwave frequency.
Such inherent flexibility in the synthesis and major applications of aliphatic organic compounds opens a new field of research in Faraday rotation.

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