Abstracts

Exploring new active materials for low-noise room-temperature microwave amplifiers and other devices

A. Blank, R. Kastner and H. Levanon. "Exploring new active materials for low-noise room-temperature microwave amplifiers and other devices." 1998 Transactions on Microwave Theory and Techniques 46.12 (Dec. 1998, Part I [T-MTT]): 2137-2144.

Newly discovered chemical systems, mainly the C/sub 60/ molecule (a molecule containing 60 carbon atoms) and porphyrin molecules (one of the basic building blocks of the hemoglobin and chlorophyll molecules) dissolved in organic solvents, have been considered as active microwave amplifying or absorbing materials. These effects are obtained under an external DC magnetic field as well as optical excitation. These materials are potentially important in certain applications in microwaves. In this paper, an attempt is made at evaluating this potential. To this end, the complex permeability of the dissolved C/sub 60/ molecules has been measured, under the aforementioned physical conditions, in three different experiments with the aid of three types of electron paramagnetic resonance (EPR) spectrometers, respectively. The permeability of the C/sub 60/ molecules, when dissolved in liquid toluene, has been found to have a negative imaginary part of about /spl mu//sub r//sup H/=-0.0055 (i.e., attenuating for the e/sup jwt/ harmonic time dependence) over a bandwidth of 0.4 MHz around the center frequency, which is known as the Larmor frequency, and is determined by the external DC magnetic field. Alternatively, the same molecules, when dissolved in a nematic liquid crystal (LC), have either positive (amplifying) or negative (absorbing) /spl mu//sub r//sup H/, with absolute value of about 0.005 over a bandwidth of 27 MHz. All measurements have been taken around the temperature of T=253 K. The lifetime of the phenomenon, during the time span that follows the laser optical excitation, is about 10 /spl mu/s. The applicability of those materials for solid state optically pumped maser amplifiers, which operate at room temperature with a very low-noise temperature or for other novel devices, is demonstrated in this paper.

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