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Electronic chips acting as capacitors or inductors when laser act as information trans mitter

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Abstract

To increase the network computer and mobile telephone capacity one needs laser to carry information instead of electrons. Since laser is very fast compared to electrons, one expect information to be transmitted very fast through the network (internet).
This requires searching for chips that acts as capacitors, inductors or evens as resistors this work shows that the laser travelling beam diminished as the frequency reciprocal thus acts as a capacitor or diminished as frequency thus acts as an inductor and sometimes diminished with the concentration of carriers thus act as a resistor for magnetic materials with strength that cancels the friction force, when the laser frequency is equal nearly to the atoms natural frequency the material act as an inductor. Then frictional force is dominant with high mobility dielectric, the material acts as a capacitor. However, it act as a conductor for negligible friction and natural frequency.

Keywords: laser, chip, capacitor, inductor, resistor.

1 Introduction

Electromagnetic waves (EMW) plays an important role in our day life. They are oscillating electric and magnetic field propagating with the speed of light c in free space. The behavior of EMW is described by Maxwell's equations [1]. Light, laser, microwave, x-rays and gamma rays are electromagnetic waves used in a side variety of applications. Radio and laser EMW are used in telecommunication, where the transmit information through the internet to mobile phones and computers [2]. Laser is used also in medicine in surgery and curing some diseases, beside other biological applications [3].
The utilization of EMW in telecommunication is the most commercially important to people. The rapid increase of people using network encourages scientists to search enabling the electronic chips to strong very large number of bits and digits, beside fast transmission of information. This needs replacing electrons by faster particles to increase information flow. These particles also need to be smaller than electrons by

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many orders of magnitude to stove more information. The particles that satisfy such requirements are photons [4]. Laser rays, which are photon streams, is suitable to be used to transmit and store information [5].
Different attempts were made to utilize laser in storing and transmitting information [6,7,8].
The work done by Christopher Monroe [3] speak about using laser in quantum computer to control floating atoms. This will enable computers to perform many calculations within almost no time. One particle can store many pieces of information [9]. This means that the behavior of atoms is on the atomic scale. The quantum laws thus control their behavior. Therefore, the control of such computers become a formidable task due to the probabilistic nature of the quantum systems. This problem can be surpassed by utilizing laser but using classical systems on the scale of more than 300nm, say on the micro scale. This needs using classical laws like Maxwell equations for laser electronic systems. Monroe inform us that on 2016 that for quantum electronic system ytterbium - 17 was used for qubits for particular states. Error - corrected universal reconfigurable ion trap quantum archetype) EURIQA began operating autonomously in April 2019 [9]. The work done by Vishal, etal [10], is concerned with using quantum laws to show how to use them for quits and gates like Not and Xor gates.
The paper showed that the prablistic nature of quantum laws allows storing very large number of information pieces of information but at the same time make the control of computer behavior very difficult [109]. In the work done by Julie change, etal [11], the cost was minimized for convolutional neural networks (CNNS) by incorporating a layer of optical computing prior to electronic computing. This system improves the accuracies of the optical system. The modeling of neural dynamics can be done with the aid of nonlinear optics. When the task of producing non-linearity is gives to electronic circuits in hybrid op to electronic circuit, the system will become more practical. This analogy is quite natural as far as the neuron cells functions are related to the electric pluses and bio photons [13,14,15]. The use of laser in electronic chips was realized by many researchers [16,17].
In the work done by Jin li and others an optical gain op to electronic oscillator based on dual frequency integrated semiconductor laser was fabricated to generate high frequency micro and milli wave frequency. The device is dual semiconductor laser. The bandwidth was widened by introducing optical amplifier instead of electric one [18]. This means that laser electronic chips are now available. The rapid grow of topological photonics can give remarkable push to quantum computers. The discovery of quantum hall effect and topological insulators in condensed matter. The topological photonics using orbital angular momentum (OAM) can be used in optical quantum computer, routing and switching [19]. Many approaches and designs were suggested for quantum electronics [20,21,22]. However no intensive work or attention were played on designing laser capacitor or inductor although many researches were done for frequency dependent conductivity [23,24,25]. This paper is devoted for laser capacitors and inductor as shown in sections (2) and (3). Sections (4) and (5) are for discussion and conclusion.

2 Laser travelling in a resistive frictional medium:

Maxwell's equations describe the behavior of moving and static charges as well as electromagnetic waves (EMW). The electric field intensity E for a medium with electric permittivity and conductivity and is given by

$$\nabla^2 E - \mu\epsilon\frac{d^2E}{dt^2} - \mu\sigma\epsilon\frac{dE}{dt} = 0 \tag{1}$$

Where is the magnetic permeability of the medium. Consider a solution in the from

$$E = E, e^{i(wt - y_a z)} \tag{2}$$

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Differentiating equation (2) with respect to space and time yields

$$\nabla^2 E = y_a^2 E$$
$$\frac{d^2E}{dt^2} = -\omega^2 E$$

$$\frac{dE}{dt} = i\omega E \tag{3}$$

Inserting equation (3) in (1) gives

$$(\gamma_a^2 + \mu\epsilon\omega^2 - i\omega\mu\sigma)E = 0 \tag{4}$$

Rearranging equation (4) gives

$$\gamma_a^2 = i\omega\mu\sigma - \mu\epsilon\omega^2 \tag{5}$$

For the electron moving with velocity in a resistive medium of coefficient γ, under the action of the electric field E, the equation of motion of the electron is given by

$$m\frac{dv}{dt} = eE - \gamma\vartheta) \tag{6}$$

Since E oscillator with time thus

$$E = E_o e^{iwt} \tag{7}$$

In this case the electron also oscillates with velocity

$$v = v_o e^{iwt} \tag{8}$$

Differentiating v in eon (8) w.r.t time and inserting this result in equation (6) gives $imw\vartheta = eE - \gamma\vartheta$

$$(imw + \gamma)\vartheta = eE \tag{9}$$

Thus, the electron velocity is given by

$$\vartheta = \frac{eE}{imw + \gamma} = \frac{e(\gamma - imw)}{m^2w^2 + \gamma^2} \tag{10}$$

For dielectric material the electric dipole moment (polarization) for n dielectric atoms por unit volume having distance x between the dipoles and charge is q given by

$$p = qnx \tag{11}$$

Thus, the current density J is given by [1]

$$J = \frac{dp}{dt} = qn\frac{dx}{dt} = qn\vartheta) \tag{12}$$

Inserting eqn (10) in (12) and using the definition of the conductivity $\sigma = \sigma_1 + i\sigma_2$ yields

$$J = qn\frac{e(\gamma - imw)}{m^2w^2 + \gamma^2}E = \sigma E = (\sigma_1 + i\sigma_2)E) \tag{13}$$

Thus, the real part σ_1 and the imaginary part σ_2 of the conductivity are given by

$$\sigma_1 = \frac{neq\gamma}{m^2w^2+\gamma^2} \qquad \sigma_2 = \frac{-mwneq}{m^2w^2+\gamma^2} \tag{14}$$

One can simplify the expressions for σ_1 and σ_2 by adopting some approximations. For instance let

$$\gamma < mw \qquad mw > gamma \tag{15}$$

In this case equation (14) gives

$$\sigma_1 = \frac{neq\gamma}{m^2w^2} \qquad \sigma_2 = \frac{-neqmw}{m^2w^2} = \frac{neq}{mw} \tag{16}$$

Since $\gamma < mw$, thus $\sigma_1 < |\sigma_2|$
Numerically

$$neq\gamma \sim n \times 10^{-38}\gamma$$
$$mw \sim 10^{-30} \times 10^{15} \sim 10^{-15} \tag{17}$$

$$\gamma \sim \frac{m}{\tau} \sim \frac{10^{-30}}{10^{-14}} \sim 10^{-16}$$

$$neqmw \sim n \times 10^{-38} \times 10^{-15} \sim n \times 10^{-51} \tag{18}$$

$$\sigma_2 \sim 10^{-23}n \tag{19}$$

$$|\sigma_2| > \sigma_1 \tag{20}$$

Since for visible light $w \sim 10^{15}$, $\quad \mu\varepsilon \sim \frac{1}{c^2} \sim 10^{-17}$ Thus

$$\mu\varepsilon w^2 \sim 10^{-17} \times 10^{30} \sim 10^{13} \tag{21}$$

Clearly, the above estimations show that

$$mw > \gamma \tag{22}$$

According to equations (16), (17), (18) and (5) with the fact that [1,26]
$\mu_o = 4\pi \times 10^{-7} \sim 10^{-6} henrym^{-1}$
$n \sim 10^{20}$

$$e \sim q \sim 10^{-19} \tag{23}$$

$\sigma_1 \sim \frac{10^{20}\times10^{-38}\times10^{-16}}{10^{-30}} \sim 10^{-4}$

$$\sigma_2 \sim \frac{10^{20}\times 10^{-38}}{10^{-15}} \sim 10^{-3} \tag{24}$$

$w\mu\sigma = w\mu\sigma_1 + iw\mu\sigma_2$
$\sim 10^{15} \times 10^{-6} \times 10^{-4} + i\ 10^{15} \times 10^{-6} \times 10^{-3} \sim 10^5 + i\ 10^6.$
But

$$\mu\varepsilon w^2 = \frac{w^2}{c^2} = \frac{10^{30}}{9\times10^{16}} \sim 10^{30} \times 10^{-17} \sim 10^{13} \tag{25}$$

Thus are can to a good approximation ignore both $w\mu\sigma_1$ and $w\mu\sigma_2$ compared to $\mu\varepsilon w^2$ in equation (5) to get

$$\gamma_a^2 = -\mu\varepsilon w^2 = -\frac{w^2}{\vartheta^2} \tag{26}$$

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$$\gamma_a = i\sqrt{\frac{w^2}{\vartheta^2}} = i\frac{w}{\vartheta} = ik \tag{27}$$

In view of eqn (2), one gets

$$E = E_o e^{i(wt-kz)}. \tag{28}$$

Which were sent a pure travelling wave with attenuation.

3 Laser electronic components for the electron equation of motion in the presence of local electric and magnetic fields beside thermal:

The local field an be induced when the external electric field displace atoms to form electric dipoles having dipole moment p. the local field strength is thus by

$$E_L = \alpha p = \alpha q n x \tag{29}$$

Where α is a constant of proportionality q is the dipole charge, x is the displacement n is the atomic concentration. Thus, the equation of motion is given by

$$m\frac{d\vartheta}{dt} = eE + E_L - \gamma\vartheta - k_0 x = eE + \alpha q n x - \gamma_o\vartheta + Be\vartheta - mw_o^2 x \tag{30}$$

$$\gamma = \gamma_o - Be \tag{31}$$

Where B is the magnetic flux density of the internal field and is the thermal vibration force. Again the velocity can become

$$\vartheta = \vartheta_o e^{iwt} \tag{32}$$

Integrating both sides yields

$$x = \int \vartheta dt = \frac{\vartheta}{iw} = -\frac{i\vartheta}{w} \tag{33}$$

Where x is the displacement. The differentiation gives

$$\frac{d\vartheta}{dt} = iw\vartheta \tag{34}$$

Inserting eqns (34), (35) in (31) gives $imw\vartheta = eE - \frac{\alpha q n}{w} i\vartheta - \gamma\vartheta + \frac{imw_o^2\vartheta}{w}$

$$[i[m(w^2 - w_o^2) + \alpha q n] + \gamma w]\vartheta = ewE \tag{35}$$

For simplicity and to gain time as well as ink and paper one can define

$$(\beta = mw^2 + \alpha q n - mw_o^2 = m(w^2 - \ w_o^2) + \alpha q n \tag{36}$$

$$\gamma = \gamma_o - Be \tag{37}$$

Thus, eqn (36) becomes

$$[i\beta + w\gamma]\vartheta = ewE \tag{38}$$

Hence, the velocity ϑ is given by

$$\vartheta = \frac{ew}{(w\gamma + i\beta)}E \tag{39}$$

The current density resulting from dipole oscillation is thus given by

$$J = \frac{dp}{dt} = qn\frac{dx}{dt} = qn\vartheta \tag{40}$$

In view of equation (40) one gets

$$J = \frac{eqnw(w\gamma - i\beta)}{w^2\gamma^2 + \beta^2}E = \sigma E = (\sigma_1 + i\sigma_2)E \tag{41}$$

Thus the real and imaginary conductivities are given by

$$\sigma_1 = \frac{eqnw^2\gamma}{w^2\gamma^2 + \beta^2} \tag{42}$$

$$\sigma_2 = \frac{-\beta\ e\ n\ q\ w}{w^2\gamma^2 + \beta^2} \tag{43}$$

If we select a material with weak internal field, and when we consider the case when the frequency w equal to w_0 . Thus

$$w\gamma > \beta \tag{44}$$

There fore

$$w^2\gamma^2 + \beta^2 \approx w^2\ \gamma^2 \tag{45}$$

One is concerned with dipole current according to eqn (41). Thus, the mass of vibrating atoms m and w for visible light have the orders

$$m \sim 10^{-26} \qquad w \sim 10^{15} \tag{46}$$

Hence

$$\beta \sim 10^{-26} \times 10^{30} \sim 10^4 \tag{47}$$

Also

$$w\gamma \sim 10^{15}\gamma \tag{48}$$

$$w\gamma > \beta \qquad \beta < w\gamma \tag{49}$$

This requires

$$\gamma > 10^{-11} \tag{50}$$

The value of $\gamma(\gamma = \frac{m}{\tau})$ for the element Bi exceeds 10^{-11} [26]. Thus the oscillating dipole should have friction more than that of the element Bi. In this case

$$\sigma_1 = \frac{eqn}{\gamma} \tag{51}$$

$$sigma_2 = -\frac{enqw}{\gamma^2 w^2} = -enq\frac{\beta}{w\gamma^2} = -\sigma_1\frac{\beta}{w\gamma} \tag{52}$$

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$$|\sigma_2| < \sigma_1 \tag{53}$$

Thus one can neglect the imaginary conductivity to get
$\sigma_2 \sim \sigma$ According to eqns (53) , (54) and (5)

$$\gamma_a^2 = i\mu\frac{weqn}{\gamma} - \mu\varepsilon w^2 = \mu w(\frac{ieqn}{\gamma} - \varepsilon w) = \mu w(i \times 10^{-38} \times 10^{11} \times 10^{20} - 10^{15} \times 10^{-11}) = \mu w(10^{-7}i - 10^4 \tag{54}$$

Thus
$\gamma_a^2 \approx -\mu\ \varepsilon\ w^2 = -\frac{w^2}{\vartheta^2} = -k^2$

$$\gamma_a = ik \tag{55}$$

In view of eqn (2) is a travelling wave in the form

$$E = \ E_o\ e^{i(wt-kZ)} \tag{56}$$

This wave is un attenuated. Now consider the resonance condition with no local field, i.e

$$w = wo \qquad \alpha = o \tag{57}$$

In this case eqn (37) gives

$$\beta = 0 \tag{58}$$

Thus eqns (43) and (44) gives

$$\sigma_1 = \frac{enq}{\gamma} \tag{59}$$

$$\sigma_1 = 0 \tag{60}$$

In view of equation (38)

$$\gamma = \gamma_0 - B_e \tag{61}$$

If one make the internal magnetic field by doping the sample with magnetic dipoles such that

$$\gamma_0 - B_e \tag{62}$$

In order to make

$$\gamma \sim 10^{-60} \tag{63}$$

In this case equation (60) gives

$$\sigma_1 \sim 10^{22}n \tag{64}$$

Since

$$w\varepsilon w^2 \sim 10^{13} \tag{65}$$

Thus one can neglect the last term in eqn (5) to get [see eqns (61) , (65) , (66)]

$$\gamma_a^2 = iw\mu\sigma_1 = (e^{90})^i w\mu\sigma_1 \tag{66}$$

Thus

$$\gamma_a = e^{45i}\sqrt{w\mu\sigma_1}$$

$$\gamma_a = \frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}\sqrt{w\mu\sigma_1} \tag{67}$$

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A direct substitution of eqn (67) in eqn (2) gives

$$E = Eoe^{i(wt-\frac{\sqrt{w\mu\sigma_1}}{\sqrt{2}}Z)}\overline{e}^{\frac{\sqrt{w\mu\sigma_1}}{2}Z}$$

$$E = Eo\overline{e}^{\frac{\sqrt{w\mu\sigma_1}}{\sqrt{2}}Z}e^{i(wt-\frac{\sqrt{w\mu\sigma_1}}{\sqrt{2}}Z)} \quad (68)$$

Thus the attenuation (absorption) coefficient becomes

$$\propto = \frac{\sqrt{w\mu\sigma_1 w}}{\sqrt{2}} \quad (69)$$

Increases with the frequency. This means that the resistance of the medium to the radiation increases upon increasing frequency. This behavior resembles that of an inductor, which has resistance increasing with frequency. This means that the medium behaves in this case as an inductor. Another case can be considered by doping the chip with magnetic dipole atoms such that

$$\gamma = \gamma_o - Be = o \quad (70)$$

In this case eqns (43) and (44) gives

$$\sigma_1 = o \qquad \sigma_2 = \frac{-enqw}{\beta} \quad (71)$$

In view of equation (37)

$$\beta = m(w^2 - w_o^2) + \propto qn \quad (72)$$

β can also be adjusted by doping the chip with electric dipoles and selecting atoms having natural frequency or alternatively when no electric dipole exist, with the laser frequency fine-tuned such that

$$\beta \sim 10^{-60} \quad (73)$$

In this case equation (72) gives

$$\sigma_2 \sim 10^{22}nw \quad (74)$$

Thus with the aid of equations (17) and (23)

$$w\mu\sigma_2 \sim 10^{30} \times 10^{-6} \times 10^{22}n \sim 10^{46}n \quad (75)$$

In view of equations (5), (21), (72) and (76), one can neglect all terms except the term (76) to get

$$\gamma_a^2 = -w\mu\sigma_2 = \frac{w^2\mu enq}{\beta} = C_o^2 w^2 \quad (76)$$

Therefore

$$\gamma_a = C_o w \quad (77)$$

Where

$$\mathbb{C}_o^2 = \frac{\mu enq}{\beta} \quad (78)$$

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A direct substitution of eqn (79) in (2) gives

$$E = Eoe^{-Cowz}e^{i(wt)} \tag{79}$$

This equation represents an oscillating wave with amplitude diminishes with distance z and angular frequency w . Thus the resistance of the medium to the wave increases with frequency. Thus, this medium acts as an inductor. This medium also allows intalgenment as far as

$$K = \frac{2\pi}{\Lambda} = 0 \tag{80}$$

Thus the wave speed is

$$v = \frac{w}{k} \to \infty \tag{81}$$

Another approach can be tackled using equation (5) by considering a travelling diminished wave. This requires defining γ_a to be in the form

$$\gamma_a = ik + \gamma_{oa} \tag{82}$$

Where conductivity and electric permittivity are complex

$$\sigma = \sigma_1 + i\sigma_2$$

$$\varepsilon = \varepsilon_1 + i\varepsilon_2 \tag{83}$$

Thus a direct substitution of equations (83) and (84) in eqn (5) gives

$$\gamma_a^2 = -k^2 + \gamma_{oa}^2 + 2k\gamma_{oa}i = iw\mu\sigma_1 - w\mu\sigma_2 - \mu\varepsilon_1 w^2 - i\mu\varepsilon_2 w^2 \tag{84}$$

Since the wave number k is given by

$$k = \frac{w}{v} = w\sqrt{\mu\varepsilon_1} \tag{85}$$

Then the two terms cancel out on both sides. Equating real and imaginary parts give

$$\gamma_{oa}^2 = -w\mu\sigma_2 \qquad \gamma_{oa} = \sqrt{-w\mu\sigma_2} \tag{86}$$

$$2k\gamma_{oa} = w\mu\sigma_1 - \mu\varepsilon_2 w^2$$

$$\gamma_{oa} = \frac{w\sigma_1 - \mu\varepsilon_2 w^2}{2k} \tag{87}$$

For elements like Ag and Cu with $\tau \sim 10^{-14}$ at 273 K [26]

$$m \sim 10^{-30} \qquad w \sim 10^{15} \qquad \gamma \sim \frac{m}{\tau} \sim 10^{-30} \times 10^{+14} \sim 10^{-16}$$

$$mw \sim 10^{-15} \tag{88}$$

Therefore

$$mw > \gamma \tag{89}$$

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Thus equations (14) and (89) gives

$$\sigma_1 = \frac{neq}{m^2w^2} \tag{90}$$

$$\sigma_2 = \frac{-mweq}{m^2w^2} = -\frac{neq}{mw} \tag{91}$$

Inserting eqn (91) in (86) give

$$\gamma_{oa} = \sqrt{\frac{neq\mu}{m}} \tag{92}$$

Inserting also eqn (90) in (87)

$$\gamma_{oa} = \frac{(\frac{neq\gamma\mu w}{m^2w^2}) - \mu\varepsilon_2 w^2}{2k} \tag{93}$$

When the internal local polarized field is in the same direction and in phase with the external field

$$\varepsilon = \varepsilon_1 \qquad\qquad \varepsilon_2 = o \tag{94}$$

$$\gamma_{oa} = \frac{neq\gamma\mu}{2m^2kw} \tag{95}$$

The term in equation (92) can be made similar to that of eqn (95) by

$$\mu\varepsilon = \frac{1}{v^2} = \frac{k^2}{w^2} \tag{96}$$

Thus inserting equation (96) in (92) gives

$$\gamma_{oa} = \sqrt{\frac{neq\mu\epsilon}{m\epsilon}} = \sqrt{\frac{neq}{m\epsilon}v^2} = \sqrt{\frac{neqk^2}{m\epsilon w^2}} = \frac{k}{w}\sqrt{\frac{neq}{m\epsilon}} \tag{97}$$

Therefore equations (97) and (83) inserted in (2) gives

$$E = Eoe^{-\frac{k}{w}\sqrt{\frac{neq}{m\epsilon}}Z}e^{i(wt-kZ)} \tag{98}$$

Equation (98) represent a travelling wave attenuated with distance Z. the attenuation rate increases upon decreasing the frequency. This means that the medium resistance to the wave increases when the frequency decreases. Therefore the medium, which is doped with electric polarized atoms or molecules, with low mechanical resistance act as a capacitor for electric circuits, where the capacitor resistance ($xc = \frac{1}{wc}$ increases when the frequency decreases. However for elements like Bi with $\tau \sim 10^{-16}$ [26], the friction coefficient takes the form

$$\gamma \sim \frac{m}{\tau} \sim 10^{-30} \times 10^{16} \sim 10^{-14} \tag{99}$$

Thus

$$\gamma > mw$$

This since $mw \sim 10^{-15}$, in the case of copper the relaxation time [1] is of the order $\tau \sim 10^{-19}$. Thus

$$\gamma \sim \frac{m}{\tau} \sim 10^{-30} \times 10^{19} \sim 10^{-11}$$

The frictional term is thus much larger than the term , i .e

$$\gamma \gg mw \tag{100}$$

Thus equation (14) gives

$$\sigma_1 = \frac{\text{neq}}{\gamma} \qquad \sigma_2 = -\frac{meqmw}{\gamma^2} \tag{101}$$

In view of equation (86) the insertion of the imaginary conductivity gives

$$\gamma_{oa} = \frac{w}{\gamma}\sqrt{neqm} \tag{102}$$

For real dielectric constant when the internal and external fields are in phase

$$\varepsilon_1 = \varepsilon \qquad \varepsilon_2 = o \tag{103}$$

Thus inserting the real conductivity in eqn (102), together with (104) in (87) gives

$$\gamma_{oa} = \frac{w}{\gamma}\frac{neq\mu}{2k} \tag{104}$$

Thus inserting eqns (105) and (83) in eqn (2) gives

$$E = E_o e^{-\frac{w}{\gamma}\ \frac{neq\mu}{2k}Z} e^{i(wt-kZ)} \tag{105}$$

This equation represent a travelling wave facing resistance proportional to the frequency. Thus this chip, doped with materials that polarize themselves in the direction of the external electric field, acts as an inductor. The chip can acts as a resistor, when using equations (37), (38) and (39). When the internal field B is adjusted by doping the chip with magnetic material such that [see (38)]

$$\gamma = \gamma_o - Be = o \tag{106}$$

i.e

$$B = \frac{\gamma_o}{e} \tag{107}$$

When also electric dipoles that generate internal field are present

$$\propto = o \tag{108}$$

Neglecting also thermal agitation when one cool the thin film or dope it with very strong bond which prevents electrons and atoms vibrations. In this case

$$wo \approx o \tag{109}$$

Thus equation (37) gives

$$\beta = mw^2 \tag{110}$$

In view of equation (39) one gets

$$v = -\frac{iwe}{mw^2}E = -\frac{ie}{mw}E \tag{111}$$

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Using the formal definition of the current density

$$J = nev = -\frac{ine^2}{mw}E = (\sigma_1 + i\sigma_2)E \tag{112}$$

Thus, the real and imaginary conductivities are given by

$$\sigma_1 = o \qquad\qquad \sigma_2 = -\frac{ne^2}{mw} \tag{113}$$

Using equation (86) yields

$$\gamma_{oa} = \sqrt{\frac{ne^2\mu}{m}} = e\sqrt{\frac{n}{m}} \tag{114}$$

This equation represents an attenuated travelling wave with attenuation and resistance proportional to the concentration of the doped material n. This indicates that the chip acts here as an ordinary resistor.

4 Discussion:

The magnetic and electrical properties of the materials or the impurities added to the host substrate determine completely and affect the laser propagation inside electronic laser chips. Section (2) shows that for a medium which has only mechanical resistance, such that the atoms are in the form of dielectrics equations (10), (12), (14) and (15) beside equation (29) show that such dielectric material enables laser waves to travel without any attenuation. Thus this material act as a conducting wire which connect electronic components with each other. The dream of scientists to use laser instead of electrons in integrated circuits and electronic chips can be realized if certain conditions are satisfied. According to equation (5) the attenuation coefficient reflects the resistance of the medium to the laser or electromagnetic radiation. Large attenuation coefficient reflects high resistance, while low coefficients reflects low resistance. This means that also when the attenuation coefficient is directly proportional to the frequency the medium acts as an inductor, which has resistance $X_L = WL$. Nevertheless, when the attenuation coefficient is inversely proportional to the frequency the medium acts as a capacitor, which has resistance ($X_c = \frac{1}{(wc)}$). The dependence of the attenuation coefficient on the frequency is through the conductivity as shown by equations (5) and (14). The interaction of the medium with EMW manifests itself through the electron equation of motion (31), beside equations (37) and (38). This interaction manifests itself through conductivity as shown by eqns (43) and (44). The properties of the medium that affect the attenuation coefficient through the conductivity are the local magnetic field B beside the local electric field in an edition to the natural vibration frequency WO and friction coefficient . Equations (58 - 70) shows that when the laser frequency is equal to the natural medium frequency, and in the absence of a local electric field, by adjusting the magnetic internal field to can cell out (see (64)) and to be just less than the friction force, in this case the attenuation coefficient is directly proportional to the frequency. Thus the medium act as an inductor in this situation (see eqn (70)). However when the magnetic force exactly can cells out friction force as shown by eqn (71), with laser frequency equal to the natural frequency, for very low doping with dielectric or electric dipoles that having very weak local field, the medium acts again as an inductor as shown by eqn (80). Another approach can be tried by assuming the laser as a travelling wave with attenuation coefficient as shown by eqn (83). When one have elements like Ag and cu with relaxation time $t \sim 10^{-13}$ or more the attenuation coefficient is inversely proportional to the frequency (see (97)). The medium thus acts as a capacitor. However for elements like Bi with $t \sim 10^{-16}$ or less (see eqn (99)), the medium doped with Bi acts as an inductor as shown by eqns (105 , 106). The chip acts also as a resistor for nonelectric, non-oscillating atoms medium having internal field force exactly cancelling the frictional force (see eqns (107 - 116).

5 Conclusion:

Using Maxwell's equations and the electron and dipole equation of motion it was shown that chips fabricated from some materials act as conductor or capacitor or resistor. For laser or light frequency nearly equal to the natural frequency, such that the local magnetic force just cancels the frictional force, in this case the material act as an inductor. The chip acts as a capacitor for nonmagnetic material with negligible natural frequency and high mobility electric dipole, which align itself in the external electric field completely. The chip also acts as a resistor for non-dielectric, nonmagnetic material with negligible natural frequency when its relaxation time exceeds 10^{-14} second.

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