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THE EFFECT OF OXIDATION NUMBER ON REFRACTIVE INDEX BASED ON STRING THEORY

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ABSTRACT

In this work we used ordinary second Newton Law for electrons affected by electric field in a viscous medium; one finds real and imaginary electric susceptibility then the refractive index; susceptibility and conductivity are related to each other. By considering the photon as string that is emitted or absorbed due to electronic transition for hydrogen like atom, the refractive index is shown to be inversely proportional to the atomic number. This relation conforms to the experiments done on Fe, Co, Ni, Cu and Cr oxides.

Keywords: refractive index, string theory, atomic number, oxidation number.

I. INTRODUCTION

When electromagnetic waves pass through matter and interact with it, three or main processes takes place. The first one is the reflection process, the second one is absorption and the third one is transmission [1, 2].

When light is transmitted from vacuum or air into transparent medium its velocity and propagation direction changes. This phenomenon is known as refraction [3, 4].Refraction is measured physically by the refractive index which relates vacuum to velocity [5].The refractive index is one of the important optical prosperities that determine the interaction of light with atoms which leads to absorption and re emission with a delay time closely related to the light medium speed [6].Although many researches are concerned with the effect of atomic structure on refractive index, but very rare are concerned with its relation to atomic and oxidation
This importance motivates doing this work which relates change of reactive index to atomic number and oxidation number of some metals.

II. REFRACTIVE INDEXES ON THE BASIS OF STRING THEORY

The refractive index plays an important role in optical properties. It's directly related to refection, refraction processes. It relates the speed of light in vacuum to its speed in the medium. It is also related to electric permittivity ε and magnetic permeabilityμ. The refractive index is given by:

$$n = c\sqrt{\mu\varepsilon} = c\sqrt{\mu_0\varepsilon_0(1+x)} \qquad (1)$$

For small x

$$n = \frac{c}{c}\left(1+\frac{1}{2}x\right) = 1+\frac{1}{2}x \qquad (2)$$

Where X stands for electric susceptibility.

For complex n and x one gets:

$$n = n_1 + in_2 = 1 + \frac{1}{2}x_1 + \frac{i}{2}x_2 \qquad (3)$$

Thus equating real and imaginary parts, one gets:

$$n_1 = 1 + \frac{1}{2}x_1 \quad (4)$$

$$n_2 = \frac{1}{2}x_2$$

One the other hand the electric flux density D is given by:

$$D = \varepsilon E = (\varepsilon_1 + \varepsilon_2)E = \varepsilon_0(E + p)$$
$$= \varepsilon_0(1 + x)E = \varepsilon_0(1 + x_1 + ix_2)E$$

There for the real and imaginary electric permittivity is given by:

$$\varepsilon_1 = \varepsilon_0(1 + x_1)$$
$$\varepsilon_2 = \varepsilon_0 x_2 \quad (5)$$

To find the conductivity of a certain medium consider an electron moving under the action of electric field in a viscous medium of

$$m\frac{dv}{d\tau} = eE - 6\pi a\mu v = eE - C_1\eta v \quad (6)$$

Where:

$$c_1 = 6\pi a$$

Assume the solution

$$v = v_0 e^{+i\omega t} \quad (7)$$
$$\frac{dv}{dt} = -i\omega v \quad (8)$$

Substituting (8) in (6) yields

$$[+im\omega - c_1\eta]v = eE$$
$$v = \frac{e}{[-im\omega - c_1\eta]}E \quad (9)$$

The viscosity η depends on atomic concentration n_0 according to the reaction

$$\eta = c_2 n_0$$
$$c_1\eta = c_1 c_2 n_0 = c_0 n_0 \quad (10)$$

Thus the conductivity is given by:

$$J = \sigma E = [\sigma_1 + i\sigma_2]E$$
$$= nev = \frac{ne^2(c_0 n_0 - im\omega)}{(c_0^2 n_0^2 - m^2\omega^2)}E (11)$$

For low frequency and large friction co efficient, the and imaginary o are given by:

$$\sigma_1 = \frac{c_0 e^2 n n_0}{[c_0^2 n_0^2]} = \frac{e^2 h}{c_0 n_0}$$
$$\sigma_1 = \frac{e^2 n}{c_0 n}$$
$$\sigma_2 = -\frac{ne^2 m\omega}{c_0^2 n_0^2} \quad (12)$$

Considering the displacement current to contribute mainly to the current, one gets:

$$J = \frac{dD}{dt} = \varepsilon\frac{dE}{dt} = -i\omega\varepsilon E = -i\omega(\varepsilon_2 + i\varepsilon_1)E (13)$$
$$= [\sigma_1 + i\sigma_2]E$$
$$= (\omega\varepsilon_2 - i\omega\varepsilon_1)E$$

Thus equating real imaginary parts yields

$$\sigma_1 = \omega\varepsilon_2$$
$$\sigma_2 = -\omega\varepsilon_1 (14)$$

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But according to equations (3), (5), (12) and (14), the refractive index becomes

$$n_1 = 1 + \frac{1}{2}x_1 = 1 + \frac{\varepsilon_1}{2\varepsilon_0} - \frac{1}{2} = \frac{1}{2}\left(1 + \frac{\varepsilon_1}{\varepsilon_0}\right)$$
$$n_1 = \frac{1}{2}\left(1 - \frac{\sigma_2}{\omega\varepsilon_0}\right) = \frac{1}{2}\left(1 + \frac{mne^2}{\varepsilon_0 c_0^2 n_0^2}\right) (15)$$

The dependence of $n_1$and Z can be found by using the definition of n in terms of v and momentum p to get:

$$n = \frac{c}{v} = \frac{mc}{mv} = \frac{mc}{p} = \frac{mc}{\hbar k} (16)$$

Treating photons as vibrating strings, one gets the relation between kinetic and potential energy for the displacement and voltage

$$x = x_0 e^{i\omega t} v = i\omega x$$

To be

$$T = \frac{1}{2}m|v|^2 = \frac{1}{2}m\omega^2 x^2 (17)$$
$$V = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2 x^2 = T (18)$$

Thus the total energy of strings is

$$E = T + v = 2T = mv^2 = \frac{m^2 v^2}{m}$$
$$= \frac{p^2}{m} = \frac{h^2 k^2}{m} (19)$$

But treating atoms as hydrogen like atoms, the energy is given by:

$$|E| = \frac{mZ^2 e^4}{8\epsilon_0^2 h^2 n^2} (20)$$

Since the photon energy in (19) results from transition between two states $(n+1)$ and$n$. Thus using equations (20) and (19) yields

$$\frac{h^2 k^2}{m} = \Delta E = -\frac{mZ^2 e^4}{8\epsilon_0^2 h^2 (n+1)^2} + \frac{mZ^2 e^4}{8\epsilon_0^2 h^2 n^2}$$
$$= \frac{2mZ^2 e^4 (n+1)}{8\epsilon_0^2 h^2 n^2 (n+1)^2} (21)$$

Thus the quantum metrical momentum is given by:

$$\hbar k = \frac{me^2 Z}{2\varepsilon_0 \hbar n\sqrt{2}}$$
$$\hbar k = C_3 Z (22)$$

Inserting equation (22) in equation (16) yields:

$$n = \frac{mc}{\hbar k} = \frac{2\varepsilon_0 h n\sqrt{2}}{e^2 Z} = \frac{C_4}{Z} (23)$$

Thus n is inversely proportion to the atomic number. The dependence of n an oxidation number nx is related to the concentration of free carriers n according to the relation

$$n = n_0 n_x (24)$$

Where n_x is proportional to the number of free electrons per atom. Thus according to equations (15) and (24) the refractive index is given by

$$n_1 = \frac{1}{2}\left(1 + \frac{mn`q1sss_x e^2}{\varepsilon_0 C_0^2 n_0}\right) (25)$$

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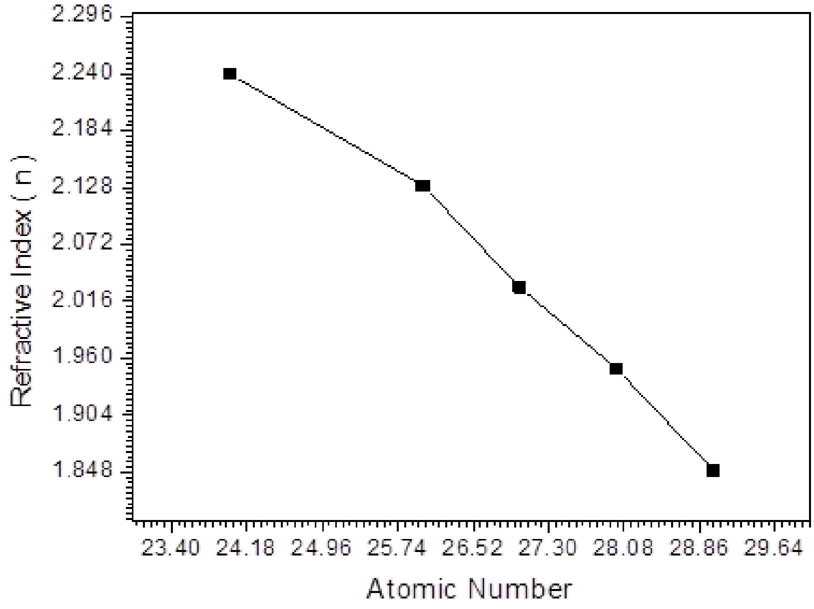
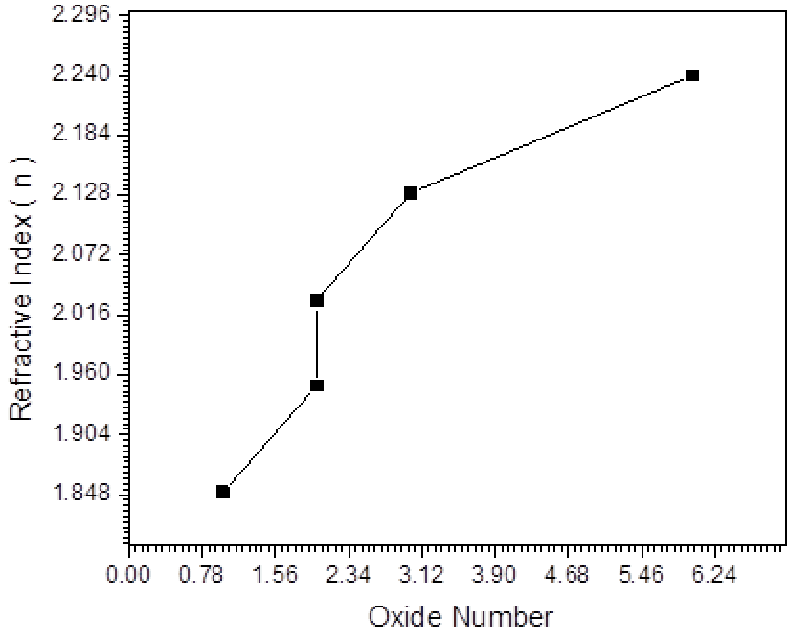
III. MATERIALS AND METHOD

The samples were made from silicon, which act as a host material, doped with some mineral oxides. The silicon is doped with *I* or n oxide, cobalt oxide, nickel oxide and chromium. The *UV* spectrometer was used to display the absorption and transmit ion spectrum. This spectrum is nothing but the wave length versus intensity near *UV* wave Length range. These relations were used to relate the refractive index to the atomic number and oxidation number. The electric and optical conductivity beside real and imaginary dielectric constants are also related to the wave Length.



Fig(1) Relationship between number Atomic and Refractive index at wavelength 415nm



Fig(2) Relationship between oxidation number and Refractive Index at wavvlength 514nm

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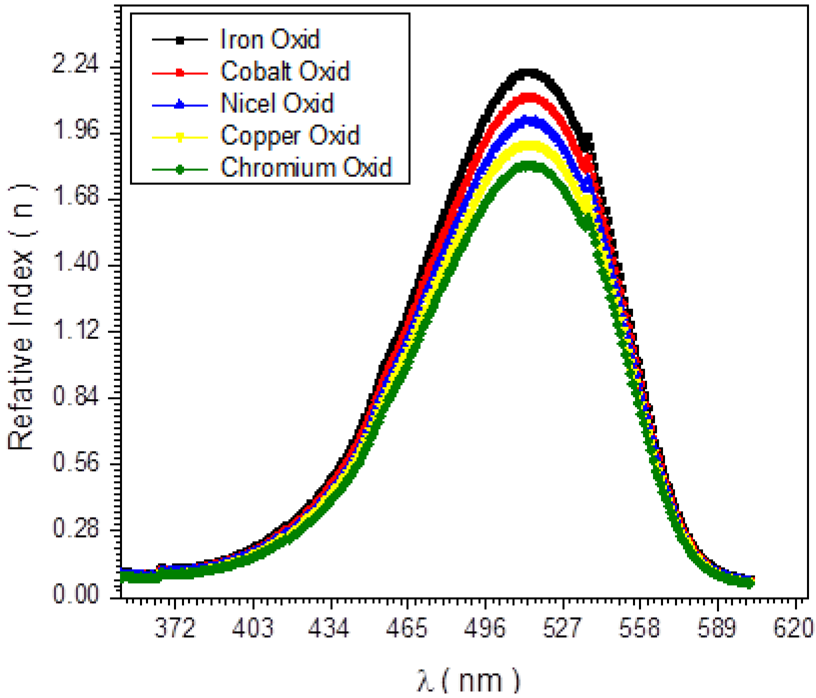
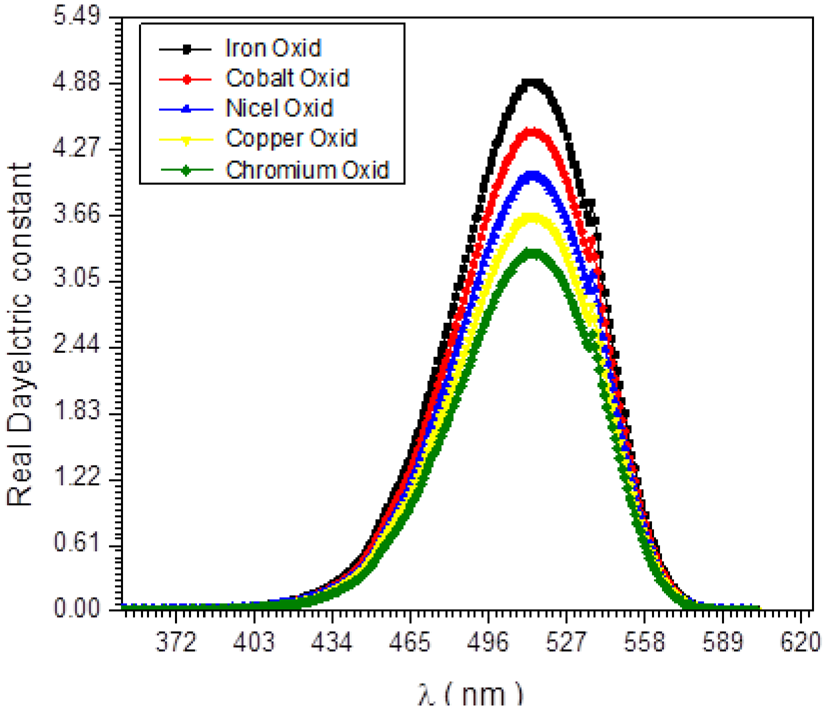


Fig(3) Refractive index n versus wavelength λ foe samples



Fig(4) Reald electric constant ε versus wavelength λ

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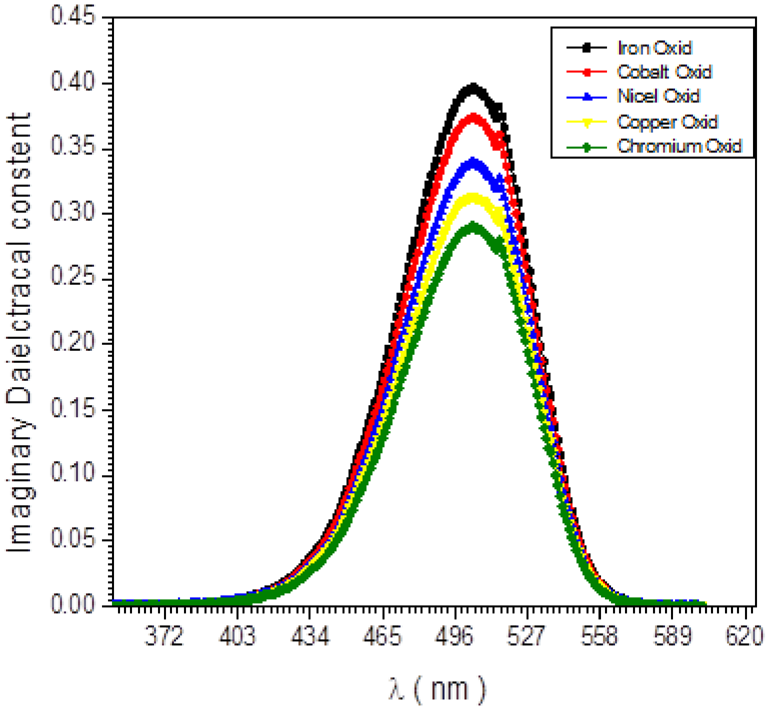
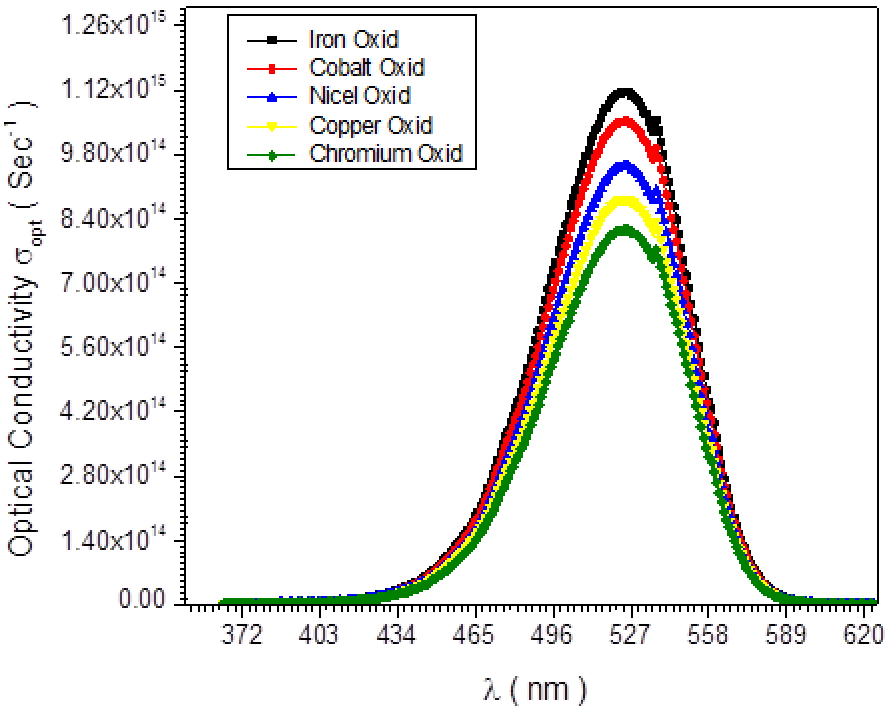
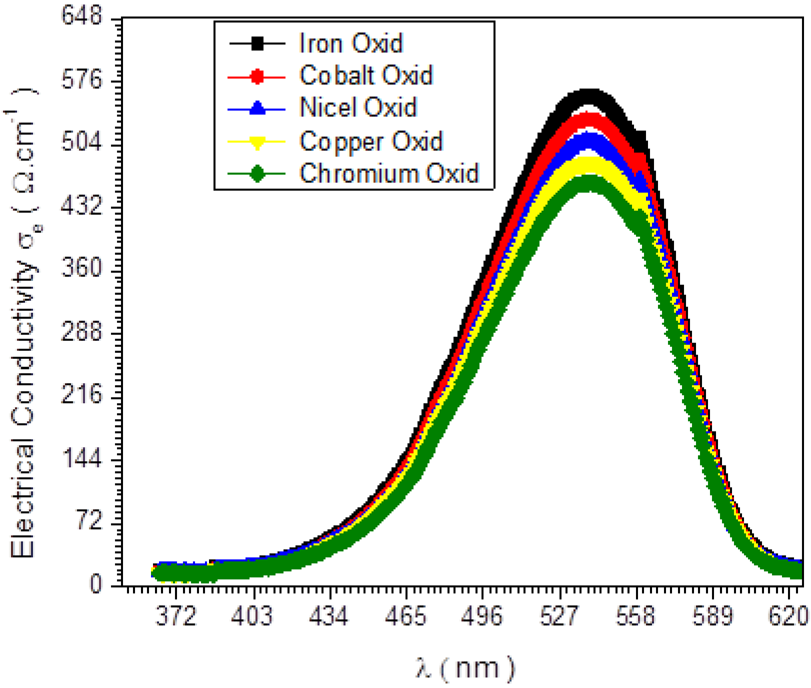


Fig(5) Imaginary dielectric constant ε_2 wavelength λ



Fig(6) Optical Conductivity versus wavelength



Fig(7) Electric conductivity versus wavelength

IV. DISCUSSION

The relation between the refractive index and the speed of Light in a medium and in vacuum is used to find a quantum expression for n as shown by equation (16).Treating photons as strings and using the ordinary expression for hydrogen like atom energy [see equation (17) to (21)] one finds the photon momentum to be directly proportional to the atomic number Z as shown by equation (22). Using equations (16) and (22) the refractive index is shown to be inversely proportional to the atomic number [see equation (23)].The viability of this equation is realized by the empirical relation between $n$and$Z$. This empirical relation shows that $n_1$is inversely proportional to$Z$.However the relation between the refractive index n_1 and oxidation number is different from that for$Z$. Using the electric susceptibility for electrons in a viscous medium [see equation 5-13]. The refractive index n_1 is shown to be directly related to the oxidation number. Surprisingly this theoretical relation is confirmed empirically by Figure (7).

V. CONCLUSION

The theoretical model treats photons as string moving in a viscous medium and causing atomic transitions. This model relates refractive index to the atomic number and oxidation number. The experiment made confirms this model.

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