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REFRACTIVE INDEX, ENERGY GAP, AND OPTICAL CONDUCTIVITY FOR WOODEN CARBON SINAG TREATED BY SOME ACIDS

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Abstract

Sinag carbon samples were prepared from wooden burning.The Four samaples were made to treat three of them by using some acids .The treatment of the three samples by the acids (HCL,HNO_3 and H_2SO_4:HNO_3mixture) .One of them is untreated. The optical properties of these samples were compared with control Multi Wall Carbon Nanotubes sample (MWCNT).The optical properties of the prepared samples have been investigated by UV/VIS spectrophotometer the absorption was found to be in the wavelength range (288 – 500) nm. The absorption coefficient is maximum for all samples compared to control and is maximum for that treated with HCL. The refractive index is less than the control for all samples in the range (315-382 nm) . The minimum value is for Sinag treated by HCL. The maximum optical conductivity is ($1.35x10^{11}$ sec^{-1}) for all samples at 357 nm, while it is at 336 nm for control. The results agree with theoretical relations.

Keywords: *wood, carbon Sinag, absorbance, conductivity, nanotubes.*

I. INTRODUCTION

Usually carbon nanotubes (CNT)powder is not pure, because it contains particles of carbonaceous Marshall's(amorphous carbon particles, fullerenes and monocrystalline polyarmatic shells) and metal catalysts (Co, Ni or Fe) .A large variety of methods such as physical separation, gas and liquid phase oxidation and combinational purification have been used to purify the CNT [1-7] .Purification processes involving physical and chemical oxidation of the CNT have been extensively investigated[1,3,7]. These processes are based on the fact that the oxidation temperature of carbonaceous particles is different for that CNT in air or oxygen [1]. However , persistent problem, associated with physical oxidation is that materials such transition metal catalysts that remain encapsulated in the wall structure can affect performance in many application [7].Physical separation is useful for the preparation of small amounts of purified coupons Gas-phase oxidation is not efficient for the removal of graphitic impurities and catalyst particles [1]. On the other hand liquid-phase oxidation is effective in removing both amorphous carbon and metallic catalyst particles. Oxidant common used in liquid phase are $HNO_3$and mixture of H_2SO_4:HNO_3 [1,7] .The problem with this method is that the acid can react with the surface and insert functional groups, those can cut and open of CNT walls .Thus non oxidative acid treatments with HCL have been also employed to purify CNT [1].This work is devoted to cure the defects beside minimizing the cost by using local carbon wastes like Sinag and available acids and minerals.

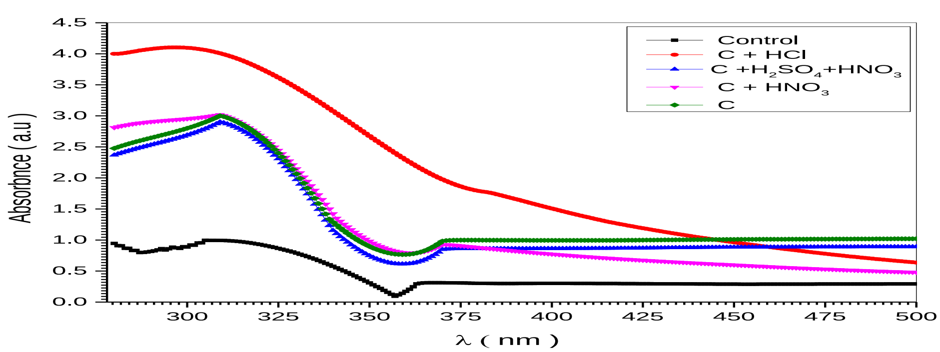
II. MARTIAL AND METHOD

Sinag samples prepared from wood burn carbon powder were formed on the steel lath by fumes. The physical properties of these samples were compared with a standard sample prepared by Hassan [12].In this standard sample Multiwall carbon nanotubes (MCNT) were synthesized by LPCVD device model (CV-6SLX).The catalyst used is iron nanoparticles (Fe NPS) having purity 99.99% and size 3nm . The device is annealed at 650°C in a path of flow of 100 sccm of Argon and 50 sccm of hydrogen and then LPCVD growth was carried out by addition of 30 of acetylene for constant timing 0f 40 minutes[12].Treatment of the new Sinag samples has been done with conventional acids treatments of non-oxidative and oxidative routs .The reaction rate of all treatments was 2g of sing powder reacted with 100ml of acid . For non-oxidative tested by HCL (36%) the samples have been left to interact for 5h. Oxidative process includes two types of treatment HNO_3 (63%) and a solution of H_2SO_4:HNO_3 (3:1). All samples were kept under reflux during 5h at temperatures between 45and 50°C (by using incubator model S150 shaking at speed 75).The samples are then removed from the heat path. After this treatment, the liquids were kept overnight in their flasks, and then were filtered with a Millipore membrane to send back SNAG powder. The filtered liquids were collected and the solid was washed with distil water until neutral pH equals 5. The sort solid was dried in an oven at temperature of 100°C for 12h under air to remove eventual moisture .The optical properties measurements shows that the absorbance is in the range from (288-500) nm .The optical characterization is done by using UV mini 1240 spectrophotometer made in a Japanese company called Shimadzu measures two types of fluids and can measure the solids in the form of slides .The device components are: light source – a cell sample – uniform wavelength – Scout – Screen. The powder samples were treated by N, NDimethyl for Hplc& spectroscopy.

III. RESULTS

The optical constant of the prepared samples have been to calculated from results that collected from UV/Vis spectrophotometer in the wavelength range (288 – 500) nm show that all fig com :-

Fig (1) The optical absorbance spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples



by acids (HCL,HNO3 and H2SO4:HNO3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

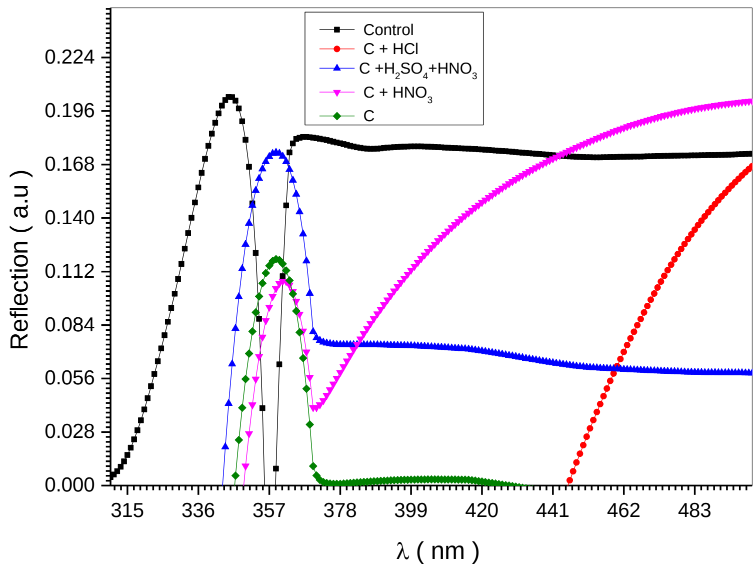


Fig (2) The reflectance spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO3 and H2SO4:HNO3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

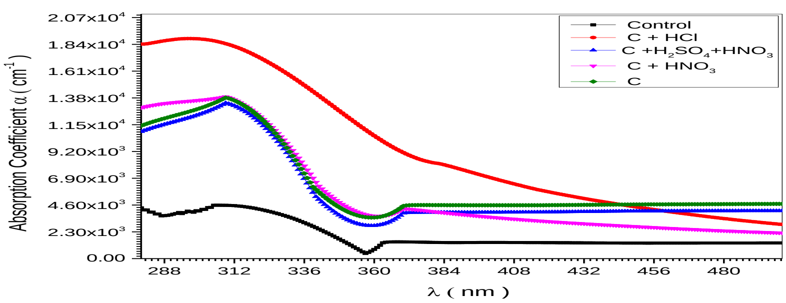


Fig (3) The variation absorption coefficient (α) with wavelength for Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT).

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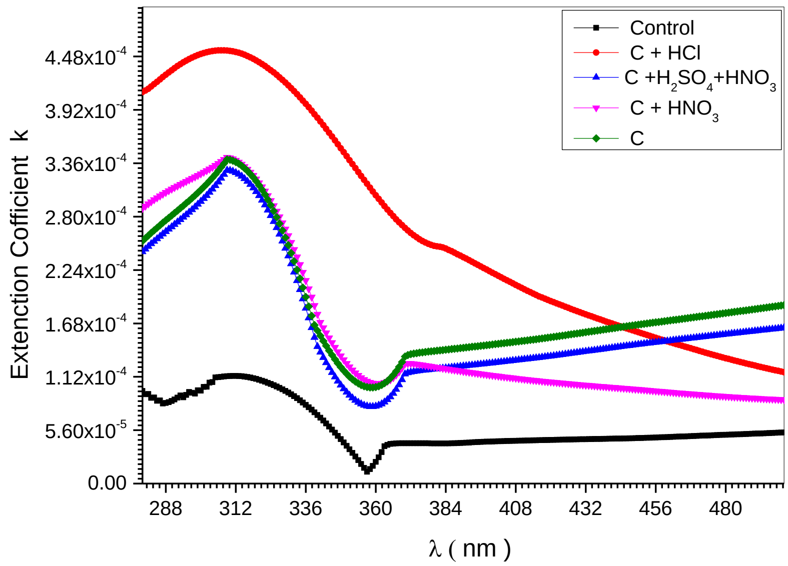
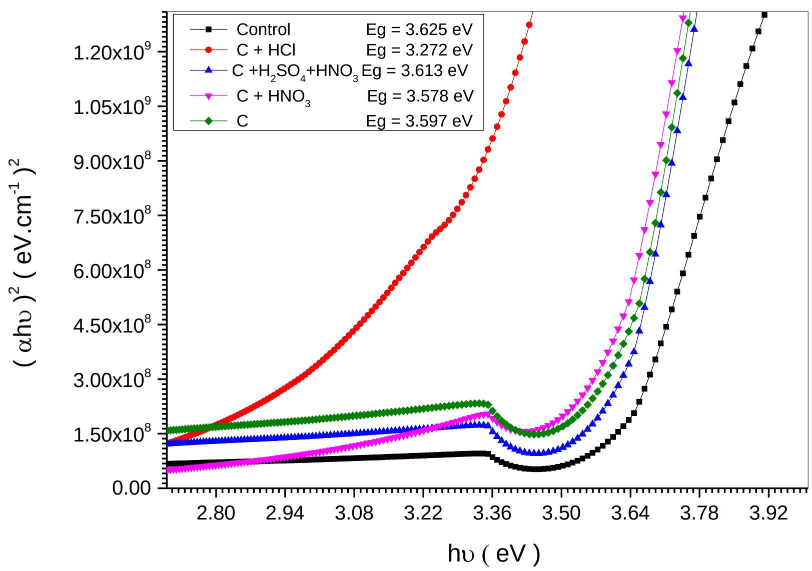


Fig (4) The Extinction coefficient (K) spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO_4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)



Fig(5) The optical energy gap (E_g) value of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO_4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

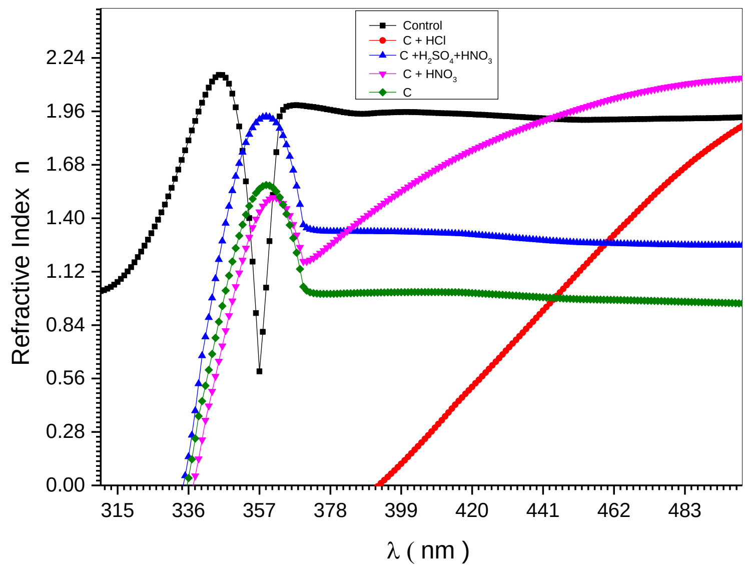


Fig (6) The refractive index (n) spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO_4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

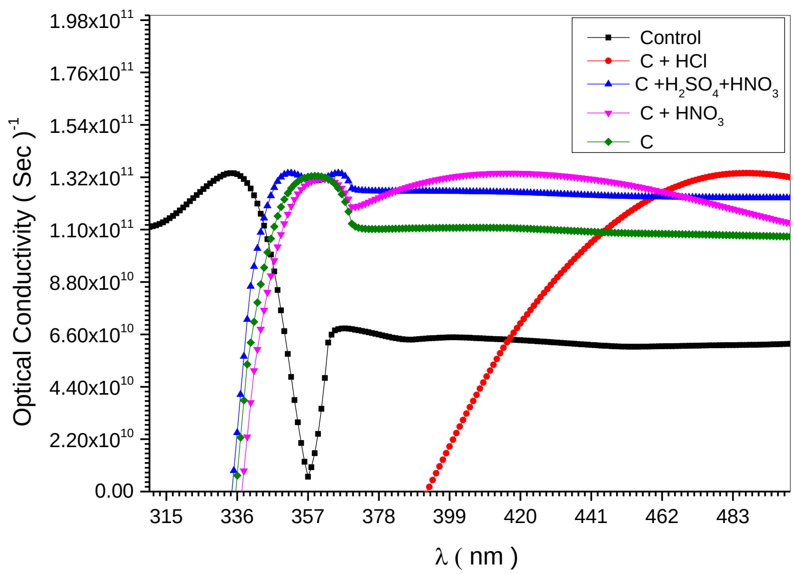


Fig.(7) Plot of optical conductivity spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO_4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

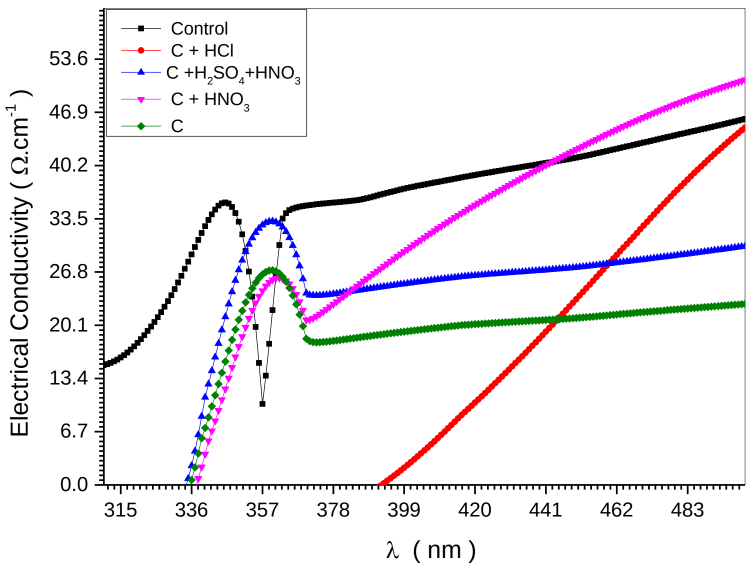


Fig.(8) Plot of electrical conductivity spectra of Wooden Carbon Sinag Purified by Some Acids ,treatment three samples by acids (HCL,HNO_3 and H_2SO_4:HNO_3 mixture) and one is un treatment and compeer by control Multi Wall Carbon Nanotubes sample (MWCNT)

IV. DISCUSSION

- The optical absorbance (A) spectra is in the (288-500) nm wavelength range for the all carbon samples depicted in fig (1). The maximum absorption at 300 nm wavelength for the sample that treatment by HCL acids equal (4.12 a.u), then decreases for all samples and the minimum absorption at same wavelength equal (0.88 a.u) for control Multi Wall Carbon Nanotubes sample (MWCNT), and the absorption remain constant at wavelength >370 , the slightest absorption occurs in (MWCNT) sample .

- Fig (2) shows the reflectance spectra and it maximum value at wavelength equal 357 nm for untreated Sinag and Sinag treated by HNO_3 and H_2SO_4:HNO_3 mixture, and in the same wavelength MWCNT has no reflectance. The maximum reflectance occurs by MWCNT at 338nm.

- Absorption coefficient (α) and the extinction coefficient (k) are obtained by relations [9]

$$\alpha = 2.303\ A/t$$

Where (A) is absorbance and (t) is the optical axes length on the sample.

$$K= \lambda\alpha/4\pi$$

Figures 3&4 shows that the absorption coefficient is large for all samples compared to the control and is maximum for Sinag treated with HCL .The same hold for extinction coefficient. This increase may be due to increase of grain size and decrease of number of defects by heat treatment [9, 13].

- The optical energy gap (E_g) has been obtained by the relation [11]

$$(\alpha h\upsilon)^2 = C\ (h\upsilon - E_g)$$

Where: (C) is constant, by plotting $(\alpha h\upsilon)_2$ Vs photon energy (hυ) figure (5) shows that the optical energy gap is less than that of the control for all samples and have minimum value of 3.272 eV for Sinag treated with HCL .It is very interesting to note that whenever the absorption coefficient is maximum the energy gap is minimum and vice versa .This agrees with the fact that the relation between energy gap and absorption coefficient is inverse relation. The decrease of energy gap may result from the decrease of density and grain boundaries due to heat treatment [9, 13].

- The value of refractive index (n) was obtained from the equation [8]

$$n = [(\frac{(1+R)}{(1-R)})^2 - (1+k^2)\,]^{\frac{1}{2}} + \frac{(1+R)}{(1-R)}$$

Where (R) is the reflectivity the variation of (n) vs (λ) shown in fig (6) for all samples is less than that of the control for wave lengths in the range (315-382 nm).The minimum value is for Sinag treated HCL sample .This conforms with the inverse relation between absorption coefficient and refractive index. The wave length at which (n) is maximum increases from 336 to357 nm. Surprisingly the max for samples coincides with the minimum for the control.

- The optical conductivity is a measure of frequency response of material when irradiated with light which is determined using the following relation[11]

$$\delta_{0pt} = \frac{\alpha n c}{4\pi}$$

Where(c) is the light velocity. The electrical conductivity can be estimated using the Following relation [11].

$$\delta_e = \frac{2\lambda\delta_{0pt}}{\alpha}$$

The optical conductivity in fig (7)shows maximum value at 357nm for all samples where it is minimum for control .The maximum .value for control is at 336nm.The conductivity for all samples is larger than that of control for all wave lengths larger than 420 nm. clearly conductivity follow absorption, which conform with theoretical models.

V. CONCLUSION

The behaviour of locally prepared carbon samples(sinag) shows higher absorption coefficient and conductivity; beside narrower energy gap and smaller refractive index compared to control .The results obtained conform with theoretical relations.

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