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Effect of Different Concentration of Iodine on Gum Arabic Crystal Properties and Morphology

H. Mustafa*[1], R.AbdElgani[2], Aldesogi Omer Hamed[3],Abdalsakhi. S. Mohammed[4], Mathany Bashir Osman[5]

[*1,2,5]Sudan University of Science & Technology-College of Science-Department of Material Science-Department of Physics – Khartoum – Sudan
[3]Kordfan University -Faculty of Education- Department of physics.
[4]Alneenlen University - and Technology Collage- Khartoum – Sudan

Abstract: *In this work, Gum Arabic (Talha) Nano-material samples were prepared withdifferent Concentration(0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar by doping with Iodine.The Nano crystal size of allsamples was fond byXRD technique, and study effect of different concentrations on theparticle Sizeand crystal properties of all samples.The densityincreasing by rat 0.5465 mg. cm^{-3}/molar. particle Sizedecreasing by rated 2.41 nm / molar,and d-spacing were decrease molar rated 10^{-10}m / molar.*

Keywords*:* Density, d-spacing, XRD technique, Nano Crystal Size. thin films

1. Introduction

Gum Arabic is a natural polymer, play an important role in our daily life. It is one of the major exported goods from Sudan more than 67% of world product is from Sudan. Gum Arabic has many uses in food stuffs and an adhesive material due to its high viscosity and also used as an additive to make stable suspension mixture for medical surprise, lithography, textiles, paint, inks, and cosmetic. Gum Arabic is most important commercial poly- saccharine and it isprobably the oldest food hydro-colloid in current use. Gum Arabic is high molecular weight polymeric compounds, composed mainly of carbon core mixed in heterogeneous manner, including some materials in tonic forms as salts of macromolecules have weak conductive properties {C+2 , Mg+2 , K+ } {FAO, 1990}.Gum Arabic is produced from many species of Acacia of African origin. Chemically, A. Senegal gum is an Arabian galactoy protein composed of arabinose {17-34%}, GA lactose {32- 50%}, rhamnose {n- 16%}, glue carbonic acid {3- 50%} and protein 1. 8-16%} with an optical rotation of {28° to 32°}.There are a lot of studies which are done in Gum Arabic but all of them are in normal uses in food stuff and adhesive material. So this study takes a different domain concerning new research in addition to identifying new application of Gum Arabic. This work is considered as conversion of (Arabic Gum) polymeric materials to become a good semiconductors material. In this work selecting Gum Arabic poultice Polymeric and added iodine where we reduced value of energy gap in semiconductors [1, 2, 3, 4, and 5].

There are three relatively simple crystal structures are found for most of the common metals:

1. The Face-Centred Cubic Crystal Structure. The crystal structure found for many metals has a unit cell of cubic geometry, with atoms located at each of the corners and the centres of all the cube faces. It is aptly called the face-centred cubic (FCC) crystal structure.
2. The Body-Centred Cubic Crystal Structure. Another common metallic crystal structure also has a cubic unit cell with atoms located at all eight corners and a single atom at the cube centre. This is called a body-centred cubic (BCC) crystal structure.
3. The Hexagonal Close-Packed Crystal Structure. Not all metals have unit cells with cubic symmetry; the final common metallic crystal structure to be discussed has a unit cell that is hexagonal. The term hexagonal close-packed brief as (HCP). The top and bottom faces of the unit cell consist of six atoms that form regular hexagons and surround a single atom in the centre [6].

Crystal System: The unit cell geometry is completely defined in terms of six parameters: the three edge lengths a, b, and c, and the three interaxial angles α, β, and γ. and are sometimes termed the lattice parameters of a crystal structure. On this basis there are seven different possible combinations of a, b, and c, and α, β, and γ, each of which represents a distinct crystal system. These seven crystal systems are cubic, tetragonal, hexagonal, orthorhombic, rhombohedral, monoclinic, and triclinic. Crystallographic planes (Miller indices): The orientations of planes for a crystal structure are represented in a similar manner. Again, the unit cell is the basis, with the three-axis coordinate system. In all but the hexagonal crystal system, crystallographic planes are specified by three Miller indices as (h k l). Any two planes parallel to each other are equivalent and have identical indices [7].

2. Material and Method

Dissolved Talha Gum Arabic, lending in distilled water each of them separately and added to a solution ofiodine in different concentration (0.1,0.30.5,0.7 and 0.9) m Molar, then placed in Petri dishes and left to dry [11, 12].The crystal structure of all samples characterized at room temperature using a Philips PW1700 X-ray diffractometer (operated at 40 kV and current of 30 mA). The infrared spectra of synthesized FTIR (Fourier Transform Infrared Spectrophotometer) in the range of 400 to 4000 cm^{-1} which used to locate the band positions which are given for all samples .

3. Results

3.1 XRD Results of (Talha Gum Arabic + Iodine) samples

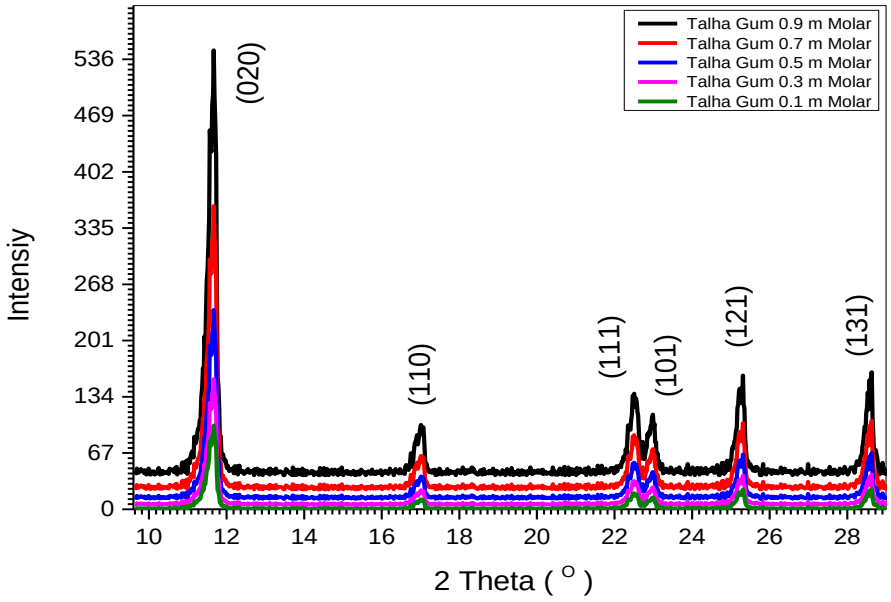

Fig (1) XRD spectrum of five Talha Gum Arabic + Iodine samples (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

Table (1) some crystallite lattice parameter (c- form , a,b,c, β,α, γ, density ,Xs(nm) and d – spacing) of five Talha Gum Arabic + Iodine samples (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

Sample	a	b	c	α= β = γ	Density	Xs(nm)	d-spesing
Hashaba Gum 0.9 m M	5.114	15.061	6.517	90	6.7460	39.14	4.1
Hashaba Gum 0.7 m M	5.114	15.061	6.517	90	6.6350	39.72	4.3
Hashaba Gum 0.5 m M	5.114	15.061	6.517	90	6.5240	40.13	4.5
Hashaba Gum 0.3 m M	5.114	15.061	6.517	90	6.4120	40.32	4.7
Hashaba Gum 0.1 m M	5.114	15.061	6.517	90	6.3110	41.25	4.9

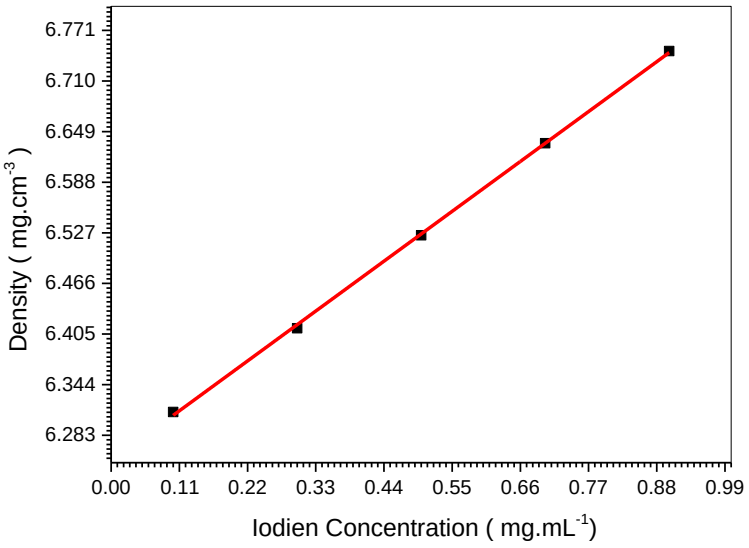

Fig (2) relation chip between Iodine concentration and density of five Talha Gum Arabic + Iodine samples (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

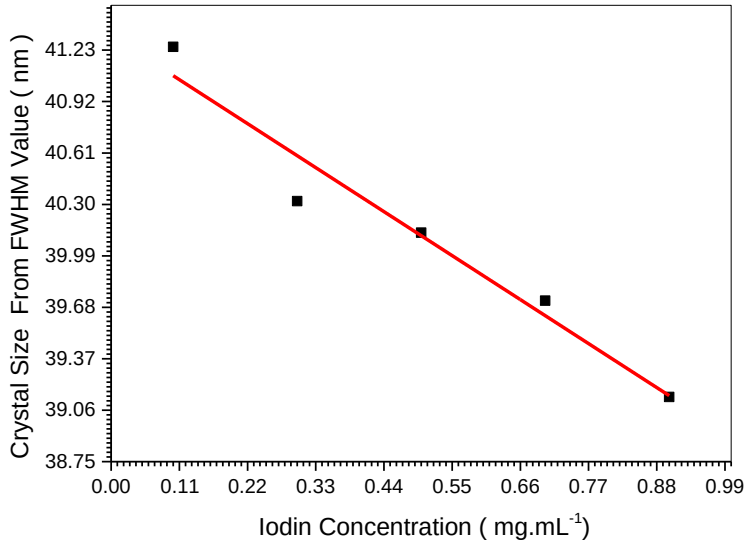

Fig (3) relation chip between Iodine concentration and Crystal Size offive Talha Gum Arabic + Iodine samples (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

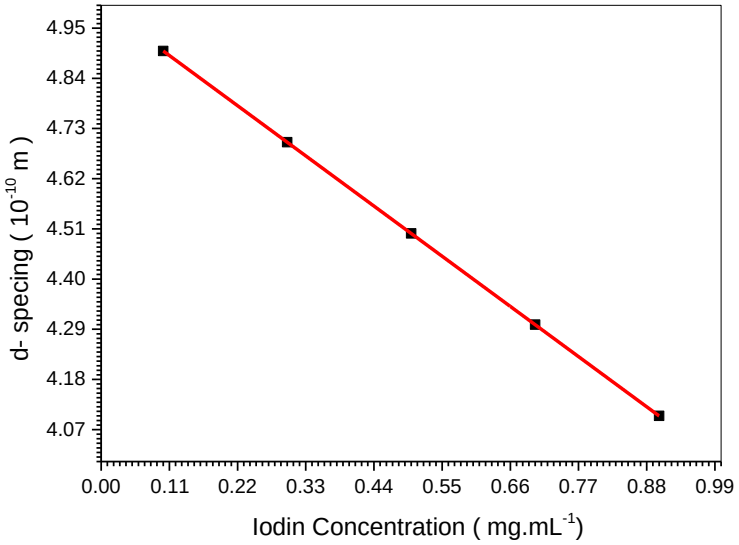

Fig (4) relation chip between Iodine concentration and d-specing of five Talha Gum Arabic + Iodine samples (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

The crystal structure of all samples characterized at room temperature using a Philips PW1700 X-ray diffractometer (operated at 40 kV and current of 30 mA) and samples were scanned between 10^{O} and 80^{O} at a scanning speed of 0.06 ^{o}C/s using Cu Kα radiation with λ = 1.5418Å. The representative XRD charts of all five Talha GumArabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar as show in fig (1) to fig (4). Miller indices provided in the figure and all peaks determine transformation of five Talha Gum Arabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar crystallites with tetragonal rutile crystal structure. Table (1) shows the XRD parameters of five Talha GumArabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar samples at various crystalline orientations. Fig (2) describes the relation between the rated molar of Talha Gum Arabic and Iodine concentration and density of samples, we showing that increase the density of sample by increasing the molar of Iodine samples by rat (0.5465 mg. cm^{-3}/molar. The dislocation density (δ) and number of unit cells (n) of Talha Gum Arabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar nanoparticles is calculated and listed in table (1). Dislocation density decreases and the by number of unit cells increases growth and decreasing the defects in crystallites. Fig (3) shows the relation between the rated of Iodene concentration and crystallite size. On the other hand, it's noticed that the rated of Iodene concentration molar increases with decreasing the crystals size by rated 2.41 nm / molar. Finally, fig (4) describes the relation between the rated of rated of Iodine concentration and d- spesing of Talha Gum Arabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar nanoparticles samples, and noticed that the rated of decreasing the d- spesing of Talha Gum Arabic samples different concentration (0.1,0.30.5,0.7 and 0.9) m Molar with increases the Iodineconcentration molar rated 10^{-10}m / molar.

3.2 FTIR of (Talha Gum Arabic + Iodine) samples

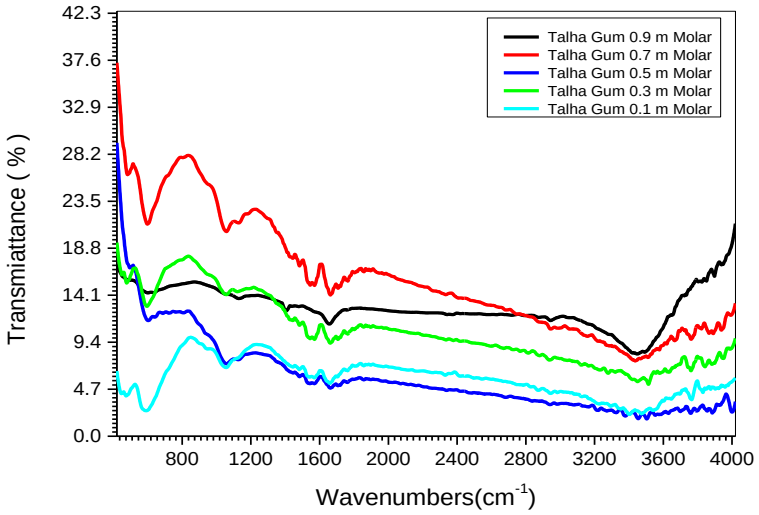

Fig (5) FTIR spectrum of five samples Talha Gum Arabic + Iodine by rate (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

Table (2) FTIR wavenumber of five samples Talha Gum Arabic + Iodine by rate (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar

No.	Sample Concentration	υ_1	υ_2	υ_3	υ_4	υ_5	υ_6
1	Talha Gum Arabic 0.9 m Molar	610	1131	1410	1659	2941	3453
2	Talha Gum Arabic 0.7 m Molar	642	1131	1395	1651	2941	3453
3	Talha Gum Arabic 0.5 m Molar	593	1131	1395	1667	2941	3437
4	Talha Gum Arabic 0.3 m Molar	602	1131	1395	1659	2378	3461
5	Talha Gum Arabic 0.1 m Molar	594	1139	1403	1667	2956	3445

The infrared spectra of synthesized fiveTalha Gum Arabic + Iodine by rate (0.1 ,0.3 ,0.5 ,0.7 and 0.9) m Molar nano samples were recorded by mattson Fourier Transform Infrared Spectrophotometer in the range of 400 to 4000 cm^{-1} which shown in Fig(5) . The spectra of all samples have been used to locate the band positions which are given in the Table (2) . In the present study the absorption bands ν1, ν2, ν3, ν4 , ν5, and ν6 are found to be around 610 cm^{-1}, 1131cm^{-1}, 1410cm^{-1}, 1659cm^{-1}, 2641$cm^{-1}$and 3453cm^{-1} respectively for all the compositions. The transmiattance bands within these specific limits reveal the formation of single-phase spinel structure having two sub-lattices tetrahedral (A) site and octahedral (B) site. The (ν1) band around610 cm^{-1} is caused by the metal-oxygen vibration in the tetrahedral sides. This difference in the spectral positions is due to the different values of metal ion-O^{-2} distances for octahedral and tetrahedral sites. The band (ν2) around 1131cm^{-1} is due to C-C stretch and C-C-H bending. The band (ν3) around 1410 cm^{-1} is associated with the O-H bending vibration .The band (ν4) around 1659 cm^{-1} is due to C=C stretching. (ν5, ν6) around 2641$cm^{-1}$and 3453 cm^{-1} is due to the stretching mode of H-O-H bending vibration of free or absorbed water which implies that the hydroxyl groups are retained in ferrites .

4. Conclusion

Crystallites with Talha Gum Arabic doping by Ioden samplesareMolar crystallites with tetragonal rutile crystal structure. The density,crystallite size and d-spacing for Talha Gum Arabic doping by Iodine increases with increases the Iodine concentration molar.

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