International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 5 Issue 4, April - 2021, Pages: 145-150

The Change of Absorption Coefficient and Energy Gap of Hashab Gum Arabic when Doped with Iodine

Mubrarak Dirar Abd-Alla[1], Nuha Hassan Kinash[2] , Ahmed Al hassan Alfaki[3] , Abdalskhi .S.M.Hamed[4].

[1]Sudan University of Science &Technology-College of Science-Department of Physics & International University of Africa-College of Science- Khartoum- Sudan
[2-3]Sudan University of Science &Technology-College of Science-Department of Physics- Khartoum- Sudan
[4]Al-Neenlen University – Faculty of Science and Technology Department of Physics- Khartoum- Sudan

Abstract: *Five samples from Hashab Gum Arabic were doped with iodine having concentrations (0.1, 0.2, 0.3, 0.4, 0.5 ppm).The energy gap were studied using ultraviolet spectrophotometer. The d-spacing and the crystal nano sizes were studied using X-ray diffraction device. Increasing iodine concentration decreases nano crystal size and d-spacing. The increase of iodine concentration increases the energy gap to take the values (2.453, 2.467, 2.473, 2.482, and 2.493 eV).*

Keywords*: Gum Arabic, Hashab, Nano size, d-spacing, Energy gap, Absorption coefficient*

Introduction

The term nanotechnology is derived from the Greek word nano, measuring dwarf [1], or something very small and depicts one thousand millionth of a meter (10^{-9} m) [2]. Nanoscience and nanotechnology refer to the science and technology of materials at the nanometer (nm) length scale, with characteristic dimensions in the range of 1–100 nm[3,4]. Materials at this length scale have unusual properties that make them interact with stimuli differently than their bulk counterparts. Optical, electrical, magnetic, chemical, and other characteristics of nanomaterials can be used to enhance sustainability in chemical and engineering processes [4]. We should distinguish between nanoscience and nanotechnology. Nanoscience is a convergence of physics, materials science and biology, which deal with manipulation of materials at atomic and molecular scales [2]; while nanotechnology is the ability to observer, measure, manipulate, and manufacture things at the nanometer scale [5].Macroscopic matter consisting of elementary unit below this dimension is called a nanometrial[3].
Gum Arabic (GA) is a natural polymer [6]. It is obtained from trees of the Acacia species such as Acacia Senegal and Acacia seyal and it is mainly produced in regions of Africa where Sudan is the world's largest producer [7]. It has many uses in food stuffs and, as an adhesive material, to make stable suspension mixtures, for medical syrapies, lithography, textiles, paint, inks, and cosmetics [6].Chemically,It is a natural polysaccharide of high-molecular weight, mainly calcium, magnesium, and potassium salts and some mineral elements. It is a water soluble polysaccharide of the hydrocolloid group, on hydrolysis yield arabinose, galactose, rhamnose and glucuronic acid [8,9]. The physical properties of gum arabic, established as quality parameters include moisture, total ash, volatile matter and internal energy [10].
Iodine was discovered by chance at the beginning of the 19th century [11]. It occurs naturally as iodide salts in seaweeds, fish, and shell fish and also in seawater [12]. It has an atomic mass 126.9044, atomic number 53, a nonmetallic element of the halogen family, appears in group 17 of the periodic table between bromine and astatine. The electronic configuration of the iodine atom is [Kr] $4d^{10}5s^2 5p^5$ [13]. It is chemically reactive and forms various inorganic and organic compounds, some with high vapor pressure. The iodide ion has a large ionic radius (2.20 A,) but is strongly polarizable, a factor that increases its ability to substitute for the hydroxyl ion in various compounds including the ferric hydroxides [14].In this work the change of Absorption Coefficient and Energy Gap was studied when hashab is doped by iodine having different concentrations. This is done in sections 3 section 2 is devoted for materials and methods while sections 4 and 5 are concerned with discussion and conclusion.

Material and Method

Five sample of Hashab Gum Arabic were doped by Iodine in different concentration (0.1, 0.2, 0.3, 0.4 and 0.5)ppm. The preparing process started by preparing Hashab Gum Arabic solution by thermo chemical method where 100 mL of methanol (Pour analysis 99%) with 50 mL (H_2SO_4) on the magnetic stiller were added to 5g of Hashab Gum Arabic. The resulting material was doped by Iodine in different concentration by chemical in ice bath for 60 min to made five samples, using an intermediate test tube for the simple. Then the annealed sample was grinded to get the powdered nanoparticles. The crystal structures of all samples were characterized at room temperature using a Philips PW1700 X-ray diffractometer (operated at 40 kV and current of 30 mA). The Energy gap and absorption coefficient were found at room temperature using min 1240 UV- Spectroscopy.

Result

International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 5 Issue 4, April - 2021, Pages: 145-150

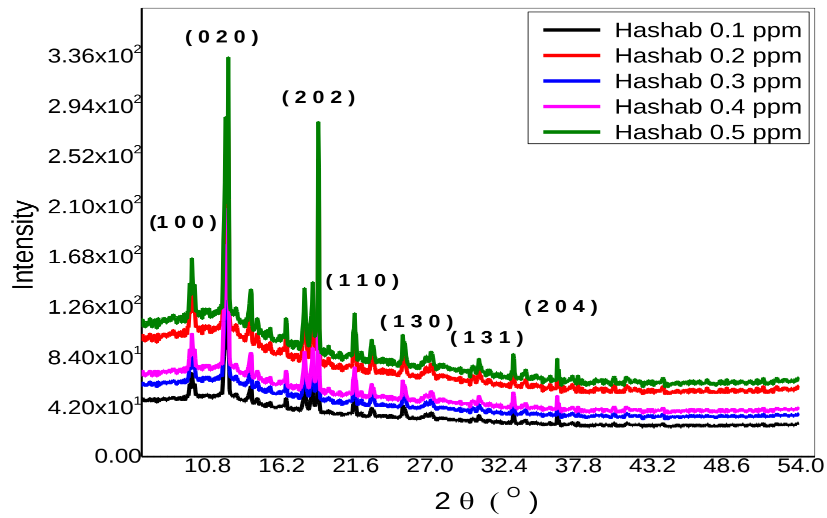


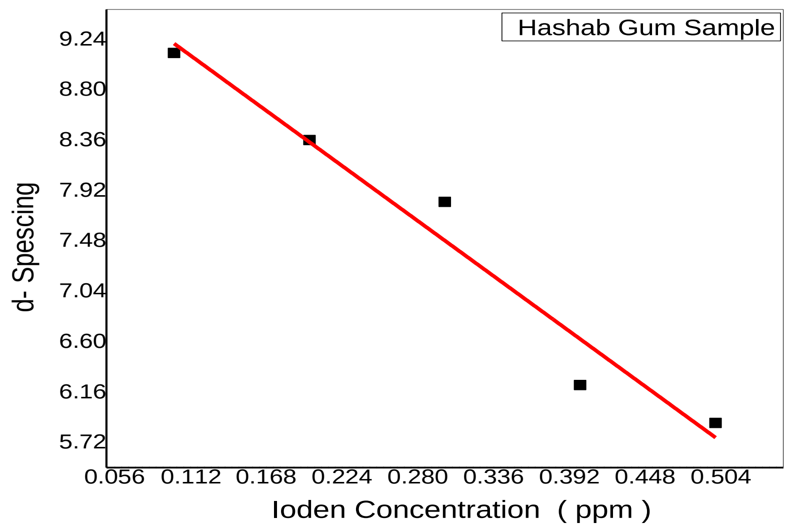
Fig (1) the XRD charts of the five samples Hashab Gum Arabic doping by Ioden

(01 ,0.2,0.3,0.4 and 0.5 ppm)

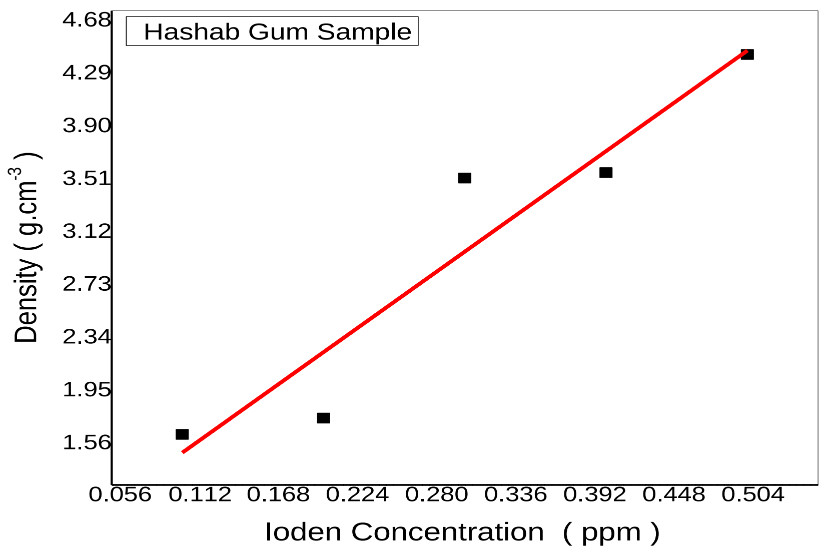
Table (1) some crystallite lattice parameter (density,Nano crystal size $X_S(nm)$ and d-spacing) Energy gap E_g and Absorption coefficient α

Iodine concentration (ppm)	**Density g/ cm^3**	**Nano crystal size $X_S(nm)$**	**d-spacing**	**Energy gap $E_g eV$**	**Absorption coefficient $\alpha\ (cm^{-1})$**
0.1	1.6227	89.25	9.12	2.453	2.04×10^5
0.2	1.7425	71.35	8.36	2.467	2.9×10^5
0.3	3.5145	66.81	7.82	2.473	3.6×10^5
0.4	3.555	58.22	6.22	2.482	4.6×10^5
0.5	4.4261	51.24	5.89	2.493	6.012×10^5

International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 5 Issue 4, April - 2021, Pages: 145-150

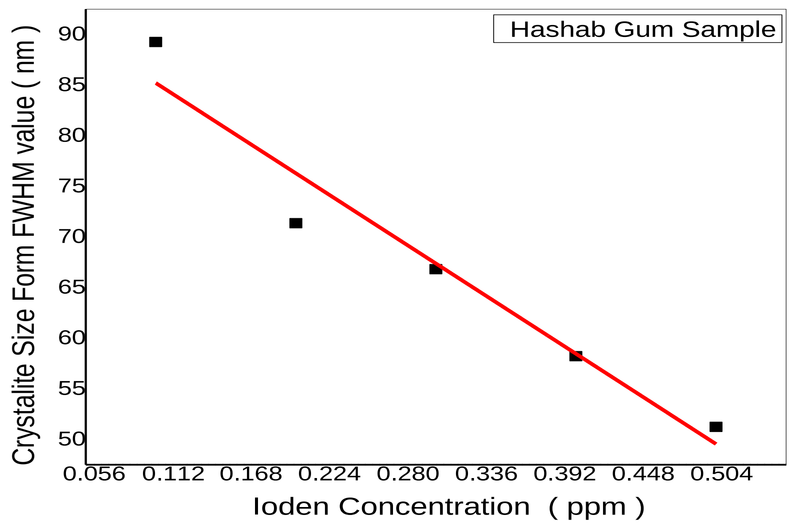


Fig(2)Dependence of the density of Hashab Gum Arbic samples on iodine concentration

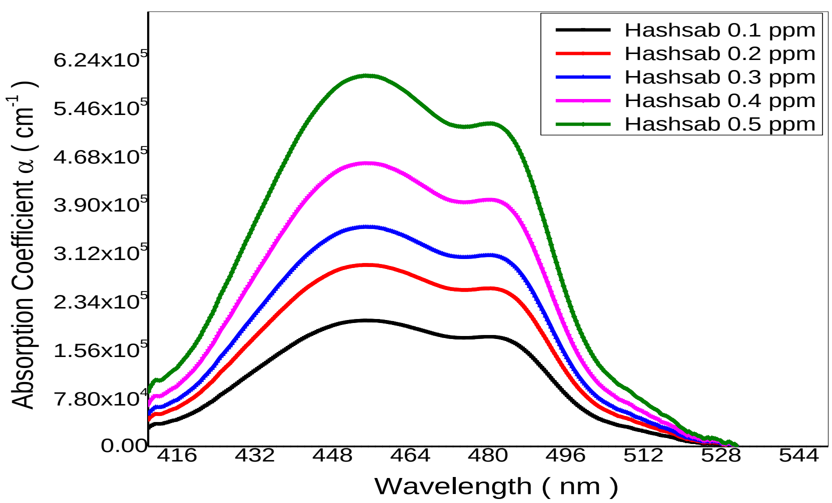


Fig(3)Dependence of the d- spacing of Hashab Gum Arbic samples on iodine concentration

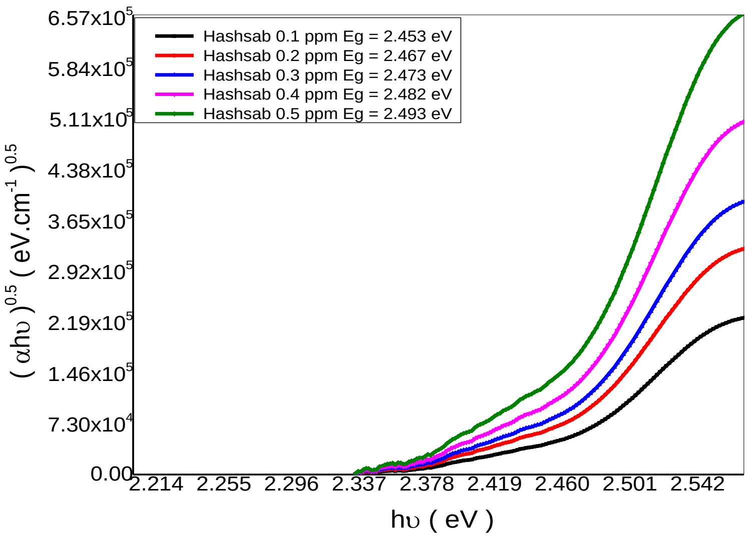
International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 5 Issue 4, April - 2021, Pages: 145-150



Fig(4)Dependence of the crystallites growth of Hashab Gum Arbic samples on iodine concentration



Fig(5) plots the relation of wavelengths vrs absorption coefficient of Hashab Gum Arabic doped by Ioden in different concentrations



Fig(6) optical energy bandgab of five sample that made by Hashab Gum Arabic doping by Ioden in different concentrations

Discussion

The X-ray diffraction patterns of the synthesized of Hashab Gum Arabic doping by Ioden(0.1 ,0.2,0.3,0.4 and 0.5) ppmhave been shown in Fig (1). The existence of the (100), (020), (202), (110) ,(130) ,(131) and (204) major lattice planes in the XRD patterns confirms the formation of spinel (Orthorhombic/C-Center for 0.1 ppm , Orthorhombic/Primitive for 0.2 ppm, Cubic /F-Center for 0.3 ppm , Hexagonal/Primitive for 0.4ppm and Tetragonal/I-Center for 0.5 ppm), Miller indices provided in the figure and all peaks determine transformation of dried Talha gum dioping by Ioden For Hashab gum the increase of iodine concentration increases the density [see figure (2)] accompanied by the decrease of d-spacing and nano crystal size as shown in figures (3) and (4) respectively.

The absorption coefficients for Hashab shown in figure (5), indicates increase of absorption coefficient upon increasing iodine concentration. This may be attributed to the fact that increase of iodine concentration increases gum density, which increases the number of atoms that absorb photons, which in turn increases absorption coefficient. For Hashab the increase of iodine concentration increases the energy gap see figure (6) to be (2.453, 2.467, 2.473, 2.482, and 2.493 eV) which also increases absorption. This may be attributed to the fact that increasing iodine concentration increases matter density which in turn increases absorption due to the increase of number of atoms.

Conclusion

The doping of Hashab gum Arabic with iodine decreases crystal spacing and nano crystal size.It increases absorption coefficient also. The energy gap increasing upon increasing iodine concentration.

References:

[1] Emerich, Dwaine F., and Christopher G. Thanos. “Nanotechnology and medicine." *Expert opinion on biological therapy* Vol. 3, Issue 4 (2003): 655-663.

[2] Bayda, Samer, et al. "The history of nanoscience and nanotechnology: From chemical–physical applications to nanomedicine." Molecules Vol. 25, Issue 1 (2020): 112.

[3] Varghese, P. I, and T. Pradeep. A textbook of nanoscience and nanotechnology. Tata McGraw-Hill Education, New Delhi (2003).

[4] Pradeep, Thalappil, et al. "Expectations for Manuscripts with Nanoscience and Nanotechnology Elements in ACS Sustainable Chemistry & Engineering." American Chemical Society (2020): 7751-7752.

[5] Mongillo, John F. Nanotechnology 101. ABC-CLIO, British (2007).

[6] Elzain, E. M. I., L. M. Mobarak, and M. Dirar. " Investigating the electric conductivity, magnetic inductivity, and optical properties of gum Arabic crystals." J. Basic Appl. Chem 2.6 (2012): 35-49.

[7] Alftrén, Johan, et al. "Comparison of molecular and emulsifying properties of gum arabic and mesquite gum using asymmetrical flow field-flow fractionation." Food Hydrocolloids Vol. 26, Issue 1 (2012): Pages 54-62.

[8] Lelon, J. K., et al. "Influence of Acacia senegal varieties on quality of gum arabic in Baringo District Kenya." African Journal of Plant Science Vol. 7(6) (2013): PP. 190-200.

[9] Anurag, Tewari. "An over view on chemistry and applications of acacia gums." Der Pharma Chemica Vol. 2 No. 6 (2010): PP 327-331.

[10] Lelon, J. K., et al. "Assessment of physical properties of gum arabic from Acacia senegal varieties in Baringo District, Kenya." African Journal of Plant Science Vol.4(4) (2010):PP. 95-98.

[11] Rosenfeld, Louis. "Discovery and early uses of iodine." Journal of Chemical Education 77.8 (2000): 984.

[12] Cooper, Rose A. "Iodine revisited." International wound journal Vol.4, Issue 2 (2007): PP. 124-137

[13] Lyday, Phyllis A., and Tatsuo Kaiho. "Iodine and iodine compounds." Ullmann's Encyclopedia of Industrial Chemistry (2000): PP.1-13.

[14] Whitehead, D. C."The distribution and transformations of iodine in the environment." Environment International Vol.10, Issue 4 (1984):PP. 321-339.