(FTIR and XRD) Spectroscopy for Thin Film Multilayers Gum Arabic Doping with Aluminum Oxide by Sol Gal method

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Abstract*: Syntheses Gum Arabic Made by (Sol Gal) Method and doping with Aluminum Oxide, and used XRD to study the crystal structure, and (FTIR) spectroscopy to measure the vibrational bonds. XRD get that molar crystallites with (Hexagonal- Primitive) crystal structure, and miller indices provided [at* **25.873** *(3 0 0), at* **30.656** *(0 1 1), at* **35.688** *(4 0 1) and at 48.604 (0 3 1)]* ***.****Fourier transform Infrared (FTIR) spectroscopy is a versatile technique for the characterization of materials belonging to the Thin Film Gum Arabic Doping with Aluminum Oxide by Sol Gal method multilayers. Most important features of this method are non-destructive, real-time measurement and relatively easy to use. By FTIR measure the vibrational of following bonds in the molecule (water O-H stretch, O–H stretch vibration of alcohol group, 1°, 2° amines, amides (N–H stretch) alkenes (–C=C– stretch) ,(C–C stretch (in–ring)) and (C–N stretch) stretching for aliphatic amines)*

Keywords : **Gum, Arabic Doping, Aluminum**

Introduction

The main gum Arabic producing regions of the Sudan, which covers most of Kordofan and Darfur state and Part of White Nile stat [1]. 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 foodstuffs 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[2]. Gum Arabic is most important commercial poly- saccharine and it is probably the oldest food hydrocolloid 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}[3].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°}[4]. Gum Arabic, also known as gum acacia, char goo, is a natural gum made of hardened sap taken from two species of the acacia tree; Acacia Senegal and Acacia seyal. The gum is harvested commercially from wild trees throughout the Sahel from Senegal and Sudan to Somalia, although it has been historically cultivated in Arabia and West Asia. Gum Arabic is a complex mixture of polysaccharides and glycoprotein's that is used primarily in the food industry as a stabilizer. It is perfectly edible and has E number E414. Gum Arabic is a key ingredient in traditional lithography and is used in printing, paint production, glue, cosmetics and various industrial applications, including viscosity control in inks, although cheaper materials compete with it for many of these roles. Chemical properties effect on surface tension in liquids .Gum Arabic reduces the surface tension of liquids, which leads to increased fizzing in carbonated beverages this can be exploited in what is known as a Diet Coke and Mantes [5].There are many studies, which are done in Gum Arabic on different domain concerning new research in addition to identifying new application of Gum Arabic. One of this study is Gum Arabic based solar cells with Rhodamin 6G were fabricated on indium tin oxide by a spin coater position. Microstructure and cell performance of the solar cells with ITO/ Rhodamin 6G/ Gum Arabic structures were investigated. Photovoltaic devices based on the Rhodamin 6G/Gum Arabic hetro junction structures provided photovoltaic properties under illumination [5].The other study was made Gum Arabic (Talha) as Nano-material doping by Iodine were prepared in different Concentration . Optical Properties of this material measured by using the UV- Spectroscopy min 1240, and study the effaced of Iodine different concentration on the optical parameters. The study reached to absorbance increases upon increasing the concentration, while the transmission decreases, and the value of Energy band gap (Eg) was decreased from (4.420) eV to (4.323) eV as increasing the concentration [6].The last one was used Gum Arabic doped by Cu O based Dye Sensitized Solar Cells (DSSC) with different type of dyes (Coumarin 500, Ecrchrom Black, Rhodamine B, DDTTc and Nile blue) were fabricated on ITO glass. Photovoltaic devices based on the Gum Arabic and dyes hetrojunction structures provided photovoltaic properties under illumination. The DSSC were produced and characterized. The analysis shows that the efficiency of the solar cell increases when the upper layer is that are more transparent [7]. The aim of this work is to syntheses Gum Arabic Made by (Sol Gal and chemo - thermos) Method and doping with Aluminum Oxide , and used XRD to study the crystal structure of all samples characterized , and used (FTIR) Fourier Transform Infrared spectroscopy is a technique used to measure the vibrational frequencies of bonds in the molecule are carried out.

Experimental

In this work, gum Arabic prepared by two methods (sol gel), .The precursor used in the synthesis gum Arabic (GA) and Aluminum Oxide (Al_2O_3). For the sol-gel process used Gum Arabic and Aluminum nitrate monohydrate, (5g) Hashab Gum Arabic dissolved in 50 ml of distillation water then 1ml ammonia added to solution .The solution was stirred for 60 min at 80°C. Moreover (2g) aluminum nitrate monohydrate Al $(NO_3)_3.9H_2O$ was dissolving in (110 ml) Ethanol C_2H_5OH in the glass beaker. Then dropped 1ml Dimethyl 2- methyl the solution was stirred for 60 min at 80°C. After that, the two solutions are mixed and put at room temperature for 24 hours, and we obtained the Sol ready to be used to prepare as layers by spinner (spin coating).. The Arabic Gum doping Aluminum Oxide was made on ITO glass. The ITO glasses were firstly cleaned by ethanol and distilled water. Then, were washed ITO glass by deionized water .Then used the that prepper mixture to deposited on ITO a glass manner Spin Coating, the coating on glass was performed at room temperature, with suitable speed rate for 60 s, for 0.02 A and 1.9V for 60 s and another layer was deposited from MEH-PPV polymer on Gum Arabic that synthase layer . Every layer from Gum Arabic coated with MEH-PPV. Four samples were prepared with Gum Arabic doping by Aluminum Oxide (Al_2O_3)(single layer sample ,bilayer sample ,triple layered and quadruple layers sample as showing in fig (1) , the thicknesses of the thin layer were about (47.7 nm for single layer, 54.4 nm for bilayer , 61.2 nm for triple layered and 75.3 nm for quadruple layers) respectively by XRD results . After syntheses four thin film Gum Arabic by (Sol Gal) Method and doping with Aluminum Oxide and MEH-PPV samples , used XRD to study the crystal structure , and used Fourier Transform Infrared spectroscopy(FTIR) to measure the vibrational of bonds as showing in the results blow .

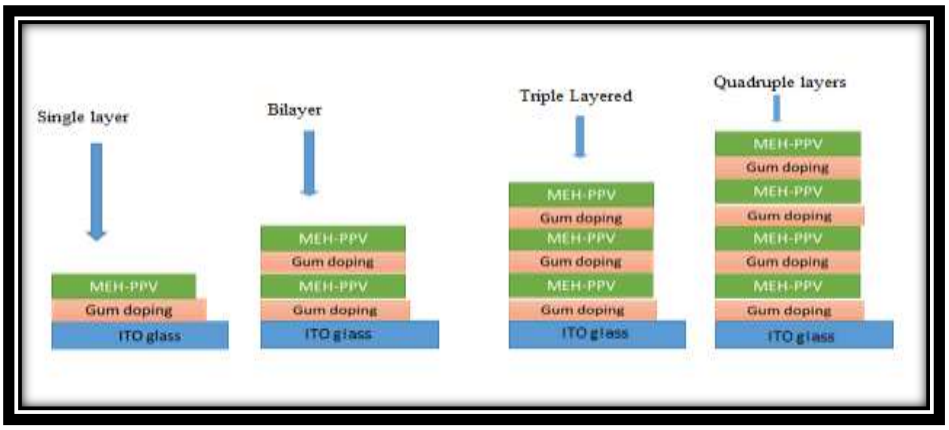

Fig (1) schematic structure of four thin film samples syntheses by Gum Arabic (Sol Gal) Method and doping with Aluminum Oxide sample and MEH-PPV

Results

After prepared four thin film multilayers of Gum Arabic by (Sol Gal) Method and doping with Aluminum Oxide and MEH-PPV samples, used XRD to study the crystal structure , and used Fourier Transform Infrared spectroscopy(FTIR) to measure the vibrational of bonds as showing in the results blow

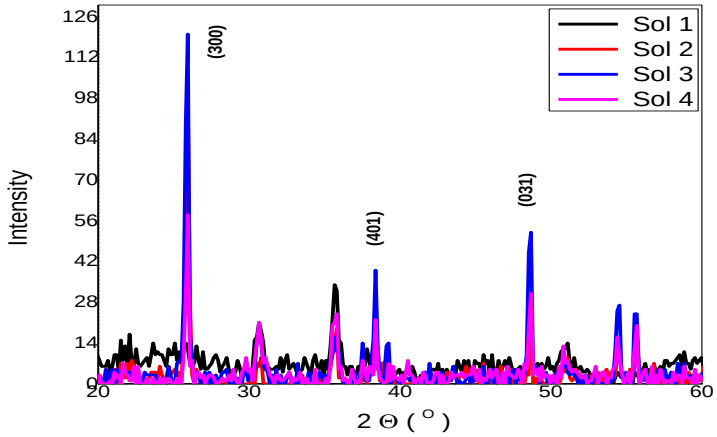

Fig (2) XRD spectrum of all sample that made from Gum Arabic doping by Aluminum Oxide sol gal method

Table (1) Calculate Lattice Constants from Peak Locations and Miller Indices of four thin film samples syntheses by Gum Arabic (Sol Gal) Method and doping with Aluminum Oxide sample and MEH-PPV

sample	d (A^0)	FWHM	Xs (nm)	δ ($mg.cm^{-3}$)
Single layer	3.4246	0.198	47.7	2.3145
Bilayer	3.4185	0.180	54.4	3.7849
Triple layered	3.3655	0.732	61.2	4.1522
Quadruple layers	3.3251	0.732	75.3	5.3423

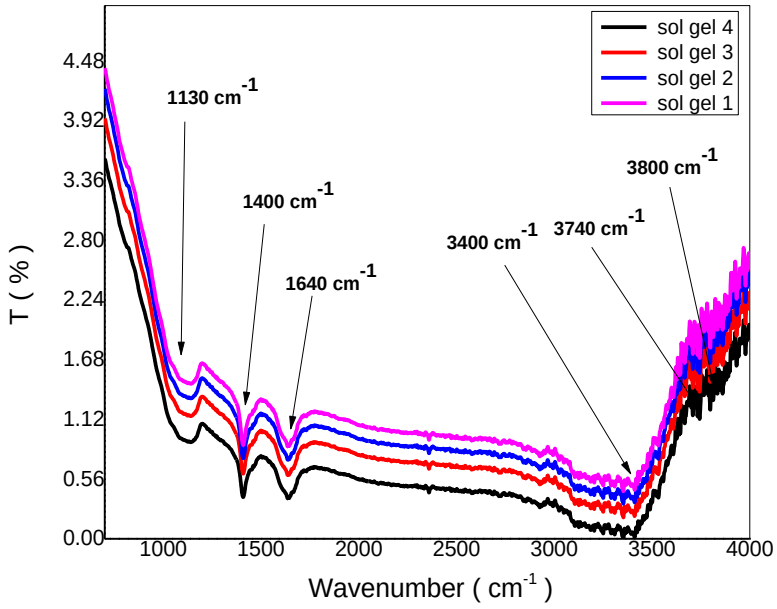

Fig (3) FTIR spectrum of Gum Arabic Made by sol Gel and doping By Aluminum Oxide

Table (2) Table of Characteristic FTIR of Gum Arabic Made by sol Gel and doping By Aluminum Oxide

no	wavenumber	bond	Funcation groupe
1	1130	C–N stretch	aliphatic amines
2	1400	C–C stretch (in–ring)	aromatics
3	1640	–C=C– stretch	alkenes
4	3400	N–H stretch	1°, 2° amines, amides
5	3740	O-H strech	Alcohoal
6	3800	O-H strech	Water

Discussion

The crystal structure of all samples characterized at room temperature using a Philips PW1700 X-ray diffract meter (operated at 40 kV and current of 30 mA) and samples were scanned between 5^O and 25^O at a scanning speed of 0.06 ^{o}C/s using Cu Kα radiation with λ = 1.5418Å. The representative XRD charts of Gum Arabic Made by (sol Gel) methods and doping By Aluminum Oxide samples as show in fig (2). Miller indices provided in the fig (1) and all peaks determine transformation of Gum Arabic Made by

(sol Gel) method and doping By Aluminum Oxide. Molar crystallites with (Hexagonal- Primitive) crystal structure. Table (1) shows the XRD parameters of Gum Arabic Made by (sol Gel) method samples at various crystalline orientations. When we describe the relation between the number of samples layers and density, we showing that increase the density by increasing the number of samples layers, and other increases the crystals size as calculated from table (1) for Gum Arabic Made by (sol Gel) method samples . Moreover, for the representative XRD charts of all Gum Arabic Made by (sol Gel) method samples. The miller indices provided in the figure (2) [at 25.873 (3 0 0), at 30.656 (0 1 1), at 35.688 (4 0 1) and at 48.604 (0 3 1)] for Gum Arabic Made by (sol Gel) method samples. Table (1) shows the XRD parameters of Gum Arabic Made by (sol gel) method samples at various crystalline orientations. The treatment method of samples; it was observed that sample treatment is confirmed the reason for the crystal structure shifts, it is clear that the Charge crystal structure with layers samples. The relation between the crystal structure number of samples layers increases density and crystals size by layers sample increases, but d-spacing of sample decreases as showing in table (1). Fourier Transform Infrared spectroscopy is a technique used to measure the vibrational frequencies of bonds in the molecule. The FTIR spectra of Gum Arabic Made by sol Gel and doping By Aluminum Oxide samples is shown in Fig (3). The strong intensity peak at 3800 cm^{-1} assigned to water O-H stretch, at 3740 cm^{-1} assigned to O–H stretch vibration of alcohol group, the band at 3400 cm^{-1} assigned to 1°, 2° amines, amides (N–H stretch) vibration. Peak at 1640 cm^{-1} assigned to alkenes (–C=C– stretch) while the very intense peak positioned at 1400 cm^{-1} revealed the presence of (C–C stretch (in–ring)) stretching for aromatics. In addition, while the very intense peak positioned at 1130 cm^{-1} revealed the presence of (C–N stretch) stretching for aliphatic amines. All this results as showing in table (2).

Conclusion

Syntheses 4 thin film multilayers of Gum Arabic by (Sol Gal) Method and doping with Aluminum Oxide and MEH-PPV samples, and study the crystal structure and vibrational frequencies of bonds in the molecule. The relation between the crystal structure number of samples layers increases density and crystals size by layers sample increases, but d- spacing of sample decreases.

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