Effects of Gamma –Irradiation the Optical Properties of Dyed Iraqi Cotton Fabrics

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Abstract

The effect of Y – irradiation (٠-١١٤٠kGy) on the optical properties (optical energy gap and Urbach edge) of dyed Iraqi cotton fabrics were investigated for the first time. For samples dyed before irradiation , it was found that the optical energy gap)Eopt(increased with dose to its maximum value (at ١kGy) before decreasing exponentially was the dose increased up to ١١٤٠ kGy . For samples dyed after irradiation , Eopt. , decreased with doses more slowly . The optical sense was found for Urbach edge)Ec(. The overall behavior suggested that the cross linking process is the dominant reaction at low doses , while at higher doses , the process was dominated by degradation , and that the presence of dye molecules during irradiation introduced significant chemical and structural changes in the cotton fabrics .

Introduction

During the last three decades there has been growing interest in the beneficial application of high energy ionizing radiation in the industry of textiles .

The radiation processing of textiles has been adequately reviewed by Al-Laami [1] and Mahmood [2] . The effects of Y – ionizing radiation (and neutrons or electrons) on cotton fibers and fabrics were studied extensively , these include , effects on the mechanical properties [٣-٦] , alkali solubility [٧] and dyeability [٨] .

There is hardly and report about the effects of gamma – irradiation on the optical properties of cotton fabrics (neither Iraqi nor others(, furthermore .

The present work is intended to investigate the effect on the optical properties of dyed Iraqi Cotton fabrics subjected to Y – irradiation (before and after dye treatment) from ٠,١ to ١١٤٠ kGy , the most interesting range .

The increasing use of gamma – irradiation in industry and medicine makes it necessary to develop simple methods of Y – ray dosimetry .

The results presented here also give new information about radiation effects on cotton fabrics al low radiation dose levels , as well as the effect of the presence of dye in the irradiated cotton fabrics .

Experimental Materials

Scoured Iraqi cotton was obtained from the general Establishment for cotton Industries .

Some cotton fabrics were dyed with (solar nawy Blue (direct) BL – 240%) . Standard dyeing processes were conducted as that being followed in the General Establishment for cotton Industries . Some cotton samples were Irradiation .

Irradiation was carried out in Canadian gamma – cell – 220 60Co irradiation facility located at the Agricultural and Biological Research Center , Iraqi Atomic Organization – Baghdad .

Batches of undyed and dyed cotton fabrics were packaged in small separate plastic containers made of polyethylene , and irradiatied in the dry state at room temperature and atmospheric pressure to different doses ranging from 0.1 to 1140 kGy in air , at dose rate around (2.7947-2.7041)kGy/hr .

Measurements

Diffuse reflectance spectra for the substrate and all irradiated cotton fabrics samples were measured at room temperature in the wavelength range 38-770nm , at 10nm intervals , by means of PU 7908/24 Integrating Spheroid [9] fitted to a Philips PU 8800 UV/VIS Double beam spectrophotometer [10] .

Measurements were usually made relative to a white standard plaque consisting of a polytetrafourethylene powder thickly presses onto a plastic substrate . It was desirable to have the sample so thick that further increase in thickness did not change the measurement [11] , furthermore, it was mounted on a flat black base . Before each measurement , the zero base line (approximately 0.3%R) and the 100%R line were recorded using standard black plaque and standard white one placed in the sample position respectively .

The output is in the form of a graphical chart in which the x-axis represents the wave length (?(, while the x-axis represents the reflectance (%R) . Data comprising points of ë and R% values have been read out of the visible display unit . The ratios of the extinction to the scattering coefficients (K/S) were calculated from the diffuse reflectance a cording to Kubelka – Munk . Equation [١٢،١٣[

$$K/S = \frac{(1-R)^2}{R^2} \text{-----------------} (1)$$

Where R is the relative diffuse reflectance .

Results and Discussion

Figs. 1 and 3 show the relation between the parameter k/s and the absorbed energy for some samples of cotton fabrics irradiated with different doses before and after dye treatment respectively . Values of K/S were calculated from Eq.1 , the estimated values of the optical energy gap (Eopt.) obtained from the extrapolation o the linear part of the curves to K/s = 0 as explained by Al-Ani etal. [14] , were against gamma – ray dose and shown in figs. 5 and 6 .

Figs2 and 4 show ln K/S as a function of the absorbed energy for the samples dyed after and before irradiation respectively , the values of Urbach edge (Ee) drived from the slopes of the linear portion of these curves were plotted against dose and shown also I Fig.5 and 6 . Values of Urbach edge indicate the width of the localized states in the band gap region of the samples .

Fig.5 show the Eopt. varies with dose for cotton fabrics dyed after irradiation , an initial increase in apparent reaching a maximum value at 1Kgy , followed by an exponential decrease attaining a value of 1.25eV at 1140kGy . Increase in Eopt. at low doses may be explained as a result of increased crosslinking which is the predominant process at low doses . Our previous studies of the effects of ɣ – ray on another properties of Iraqi cotton fabrics supported the formation of crosslinking at low doses as revealed by a decrease in dyeability]٨[, and an increase in tensile properties [٣-٦[.

For cotton fabrics dyed before irradiation , Eopt exhibited a similar behaviour but it decrease more slowly at high doses reaching a value of ١,٦٢٥ eV at ١,١٤ Mgy as shown in Fig,٦ , this can be attributed to the presence at dye molecules .

For both samples (dyed before and after irradiation (the variation of Ee with dose seems to be nearly opposite to that of Eopt as a mirror (Figs,٥ and ٦) , as usual when Ee increases , Eopt decreases for the same sample , and vice versa .

Actually , there have been no pervious report dealing with the effect of γ – ray on Eopt and Ee for dyed cotton fabrics (neither Iraqi nor others) , so that a comparison is not being made . Our previous study [١] on undyed Iraqi cotton fabrics shows just the opposite bahviour for both Eopt and Ee with dose , this indicates that significant chemical changes are introduced in the cotton fabrics as a result of Y – irradiation before dye treatment (in case of samples dyed post irradiation) which lead to changes in their dye acceptability where the dyeability decreases at low doses and increases as higher doses , as stated before [١] . For samples dyed pre irradiation the present results show that dyeing processes caused structural changes in the cotton fabrics .

Conclusions

In the course of the obtained results , the following confusions can be drawn :

1- Irradiation at low doses (0.1-1 kGy) in creases the optical energy gap (and decreases Ee) of dyed cotton fabrics as a result of crosslinking while at high doses , a decrease in Eopt. (and an increas in Ee) was observed with increasing dose , is much more for samples dyed post irradiation than those dyed pre irradiation indicating that the presence of dye molecules during irradiation introduces significant chemical change in the cotton fabrics especially at high doses .

2- The differences between the present results and the previous ones for undyed cotton fabrics indicate that Y -ray introduced significant chemical and structural changes in the cotton fabrics dyed post or pre irradiation .

٣- The parameters Eopt. And Ee have not been previously reported for dyed cotton fabrics and are useful for characterization .

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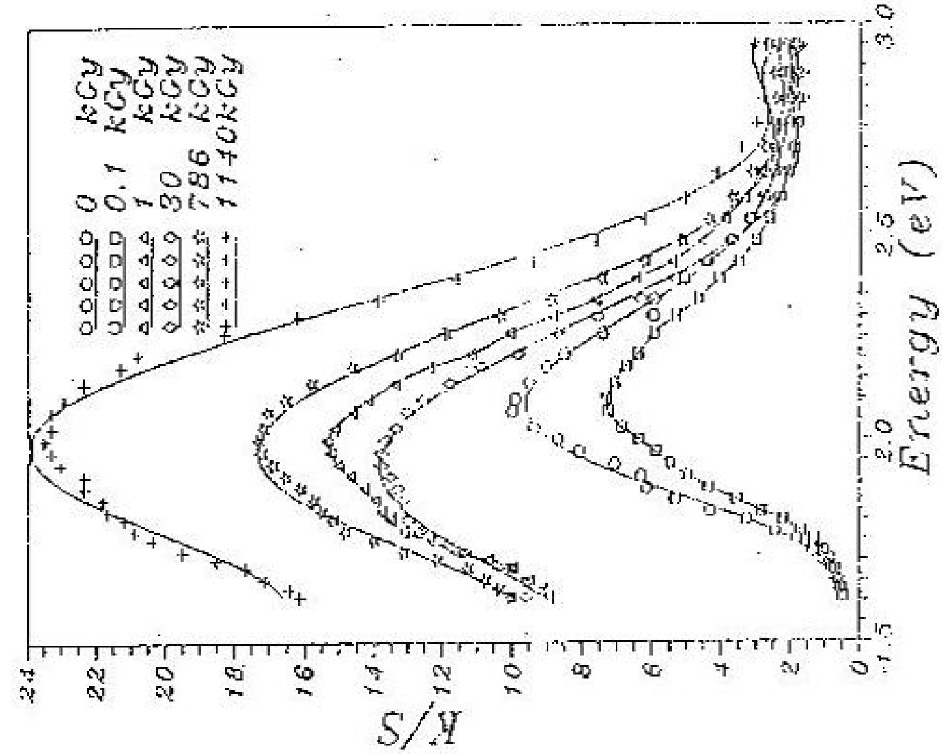
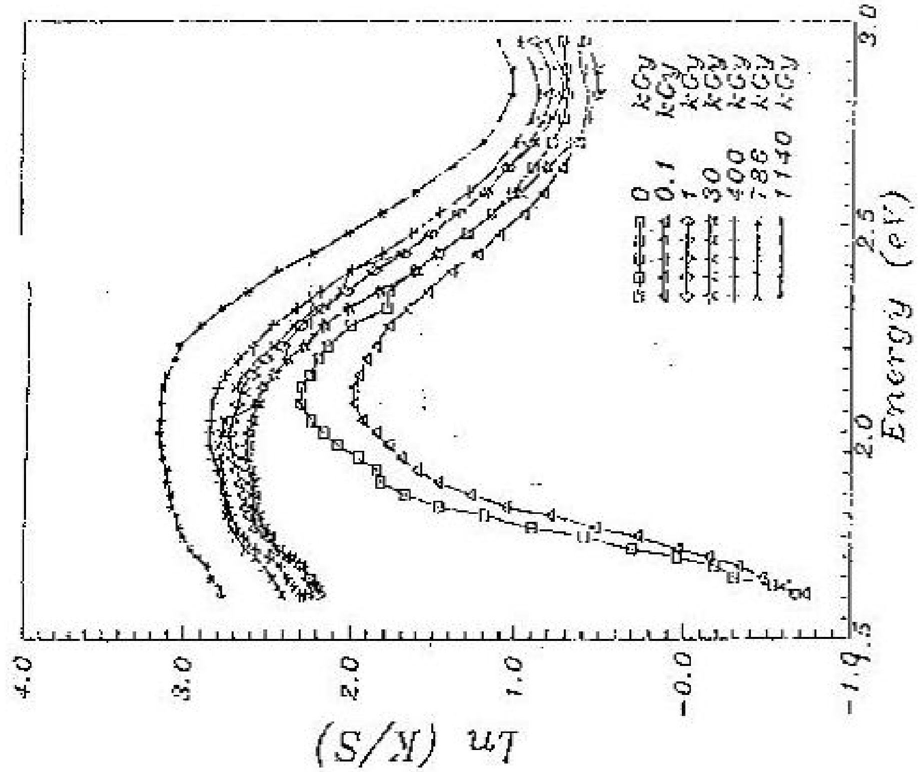
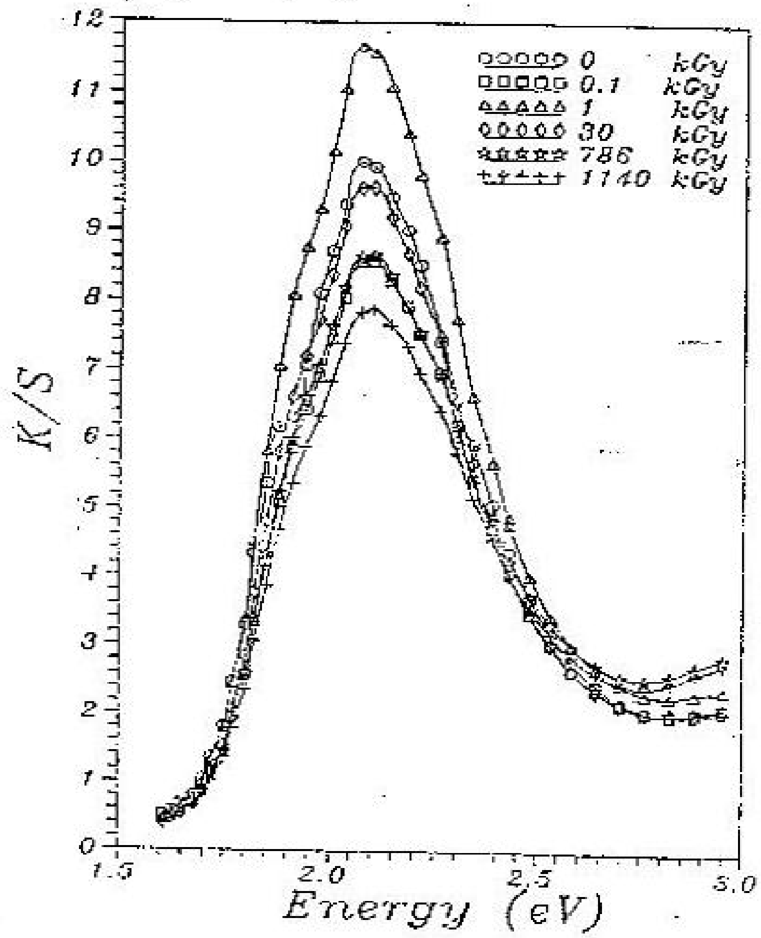


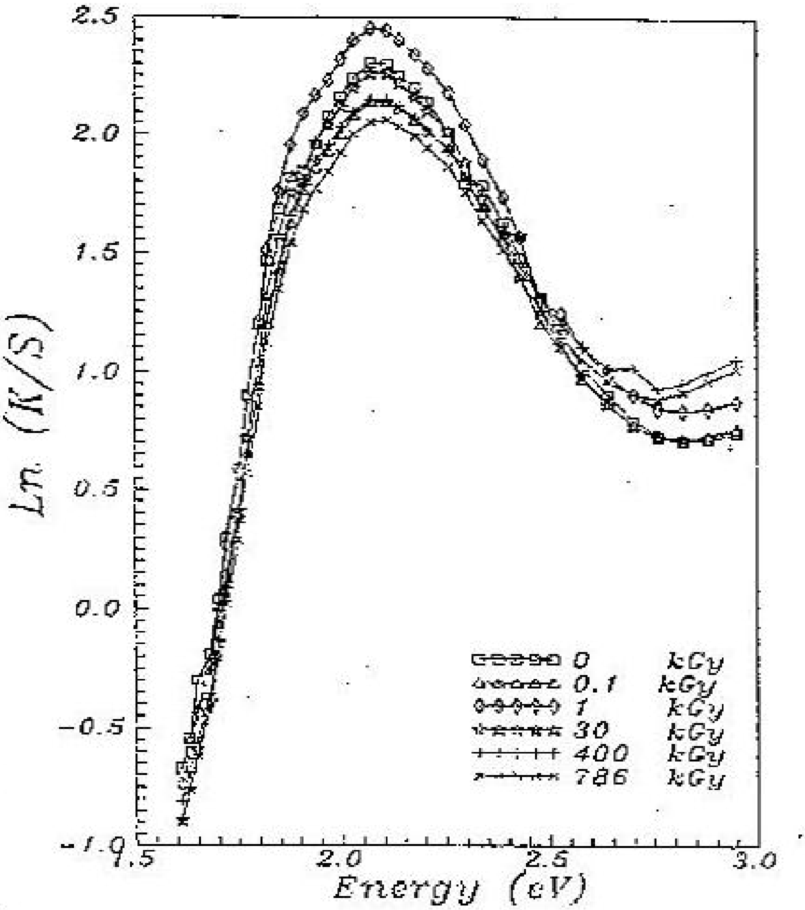
الشكل (1) K/S كدالة لطاقة الفوتون الساقطة للغشاء قبل وبعد التشعيع بالأشعة كاما بجرع مختلفة من أشعة كاما.



الشكل (2) Ln (K/S) كدالة لطاقة الفوتون الساقطة للغشاء قبل وبعد التشعيع بالأشعة كاما بجرع مختلفة من أشعة كاما.



الشكل (3) K/S كدالة لطاقة الفوتون للعينة القطن المصبوغة قبل التشعيع والمشععة بجرع مختلفة من اشعة كاما.



الشكل (4) Ln (K/S) كدالة لطاقة الفوتون لأنسجة القطن المصبوغة قبل التشعيع والمشععة بجرع مختلفة من أشعة كاما .