Dielectric Properties of Irradiated and Non Irradiated Muga (Antheraea Assama) Silk Fibre in Presence of Oxygen at Elevated Temperature

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Abstract.
In presence of oxygen the dielectric properties such as dielectric constant (ε′), dielectric loss factor and dielectric loss tangent of Muga fibre are studied in audio frequency range at different temperature. The range of the temperature is 303K to 573K.It has been seen that in presence of oxygen an additional peak is arises for the curve of dielectric constant and temperature, which is not seen when the experiment is carried out in vacuum and in air medium.The values of dielectric constant, dielectric loss factor and dielectric loss tangent at 323K & at 473K for irradiated Muga fibre in presence of oxygen are 2.31, 0.231, 0.1 & 5.03, 2.012, 0.4 accordingly. These values for non irradiated sample are 4.96, 0.496, 0.1 & 67.49,128.23,1.9 respectively.

Keywords. *Audio frequency, dielectric constant, dielectric loss factor, Dielectric loss tangent, irradiation, Oxygen, Silk fibre.*

I. INTRODUCTION

The natural silk fibre muga (Antheraea assama) are organic polymers[1]. The common character and properties such as thermal, chemical and physical of organic textile fibre depends on the high polymeric compounds that constitute the fibre.One of the main objectives of polymer physics is the elucidation of interconnection between the structure and the physical properties of polymers. A profound knowledge of the interconnection between the structure and properties makes it possible to control the production and quality of textile fibre and regulate their specific consumption depending upon the condition for their use or processin The silk fibre muga are semicrystalline and hygroscopic in nature[2]. The study of the thermal behaviour of these fibres has great importance in textile and other indistrial field. The impotance of study of degradation of polymer under the action of high energy such as □ -radiation has been attached[3,4]. The most important kind of chemical degradation are oxydative degradation. Heat intensify the oxydative degradation. Amongst the physical properties of textile fibre the dielectric properties is one of the most important property of the fibres. Dielectric properties of polymeric and cellulosic yarn and febric have been studied by some investigators [5-9].
In present investigation attempt have been made to study the dielectric properties of raw and irradiated muga fibre in presence of oxygen.

II. MATERIALS AND METHODS

2.1 Sample collection.

Muga coocons were collected from ‘Howly Govt. silk firm’ located in Assam. After collecting coocons the fibres were extracted from it.

2.2 Sample preparation.

The fibres were divided into two parts. One part is used as raw sample and other part is irradiated and used as irradiated sample.

2.3 Irradiation.

One part of the raw muga fibres have been expossed to γ - radiation of dose 2.4×10^3 rad. The fibres have been irradiated by the ‘PHOENIX’ Theratronics made. The irradiations are carried out using the cobalt - 60 source. The samples are irradiated at low energy γ - dose rate ranging from 0.34×10^6 to 0.44×10^6

roentgens per hour. Calibrations are done at BARC, Bombay.For irradiated the samples, the raw fibres are packed into saperate paper envelops. The surface area of the envelop is 10.2 × 10.2 cm.^{2} . They are placed at 45.7 cm. distence from the γ - emitter. The samples are irradiated in 298 K and 65 % r.h.

2.4 Methods

The experimental arrangement for dielectric measurements consisted a frequency osciullator (Agronic), an insulating transformer of type TM7120 (Marconi) and universal bridge of type TF2700 (Marconi).The experimental arrangement and measurement were taken by the method describe elswhere[10,11]. Here an additional part for oxygen supply has attached. For this a glass tube with stop cock is joined with the main tube. The other end of the tube is connected with an oxygen cylinder.

III. RESULTS AND DISCUSSION.

The colour of raw muga fibres are golden yellow. When raw muga fibres are irradiated by γ - radiation of dose 2.4 × 10 ^{3} rad it has noticed that the lustre of the fibre is increased.The observed values of dielectric constant (ε′) at different temperature (T) for raw and irradiated samples in presence of air and in presence of oxygen at the frequency 1 KHz are displayed in table 1.

Table 1. Dielectric constant (ε′) of raw and irradiated muga fibres at different temperature (^{0}K)

^{0}K	Ra	Ro	Ia	Io
303	8.58	8.54	10.87	2.72
323	8.36	4.96	8.40	2.41
373	4.40	11.12	4.94	2.31
423	4.40	15.28	4.94	9.05
473	5.50	51.61	4.94	5.03
525	7.92	3970.00	7.41	20.00
543	6.56	3570.00	8.40	98.59

Samples : Ra -raw in air , Ro - Raw in oxygen,

From the table 1 it is observed that the values of dielectric constant are very high in presence of oxygen at elevated temperature. The values of dielectric constant for the fibres in air medium are gradually increased. This variation may be based on the agreement that due to increase of temperature the rotations of sides groups and also by the segmental mobility of the fibre constituents occur.

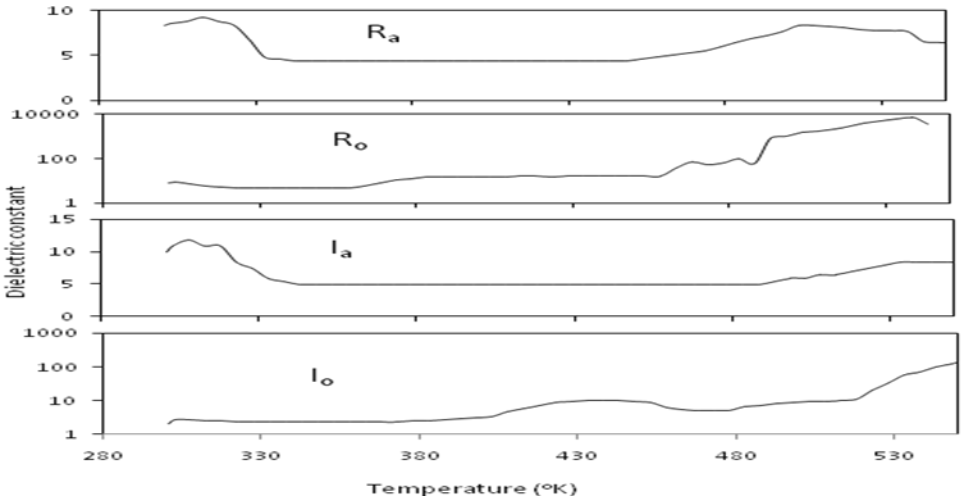

Figure1. Dielectric constant (ε′) of raw and irradiated fibres at different temperature in presence of air and oxygen (Samples : Ra -raw in air , Ro - Raw in oxygen, Ia-irradiated in air, Io-irradiated in oxygen

The variations of (ε′) and temperature for the fibre at air and oxygen at the frequency 1 KHz are shown in fig 1. From the figure it has also been seen that the degradation temperature has decreased and decomposition peak arises in the temperature range 300 to 500 K in presence of oxygen. This may be due to increase of the rate of thermal degradation in presence of oxygen[12]. From figure 1 it has also seen that the glass transition temperature has decreased in oxygen medium.The observed values of dielectric loss tangent with temperature for the raw and irradiated fibres in the medium of air and oxygen. are displayed in table 2. From table2 it has found that at low temperature the values of doelectric loss for the fibre in the air medium are less than those of the fibres in oxygen medium. But at high temperature the dielectric loss is greater for the fibres in air medium than those of the fibres in oxygen medium. This indicates that the dielectric loss has decreased in presence of oxygen at higher temperature. Figure 2 represent the variation of dielectric loss tangent with temperature for the raw and irradiated fibres in the medium of air and oxygen.

Table 2. Dielectric loss tangent of raw and irradiated muga fibres at different temperature (^{o}K) in presence of air and oxygen at the frequency 1 KHz.

^{o}K	Ua	Uo	Ia	Io
303	0.08	0.40	0.08	0.10
323	0.90	0.10	0.90	0.10
373	2.98	0.60	2.98	0.09
423	5.01	0.90	5.01	0.70
473	7.01	3.50	7.01	0.40
525	9.04	3.80	9.04	1.70
543	9.86	3.80	9.86	2.20

Samples : Ra -raw in air , Ro - Raw in oxygen, Ia-irradiated in air, Io-irradiated in oxygen.

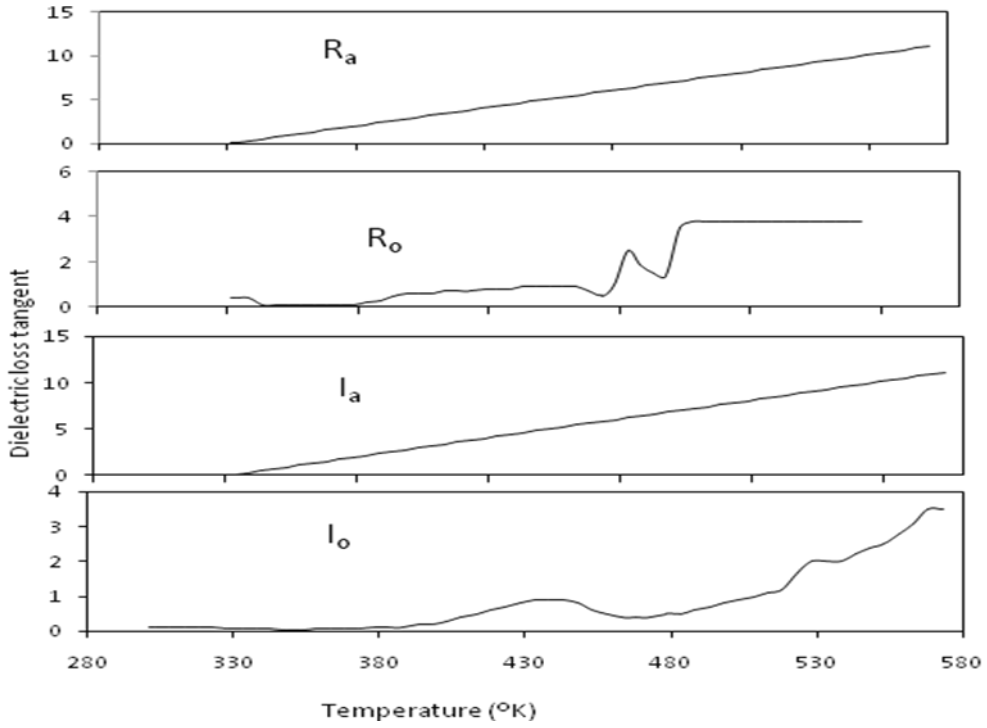

Figure 2. Dielectric loss tangent of raw and irradiated fibres at different temperature (^{o}K) in presence of air and oxygen at the frequency 1 KHz. (Samples : Ra -raw in air , Ro - Raw in oxygen, Ia-irradiated in air, Io-irradiated in oxygen.)

From figure2 it has been seen that the dielectric losses of raw and irradiated fibres in air are linearly increased with the increased of temperature. The simillar result had been obtained for some non irradiated cellulosic fibres[13].

From the figure it is seen that some peaks are arises for the dielectric loss tangent in presence of oxygen. This may occur due to the change of physical state of the fibres in presence of oxygen , because the dipolar contribution to the polarisation take time to its static position vary between days and 10^{-12} second depending on temperature, chemical constitution of the material and physical state[14].

IV. CONCLUSION.

The degradation and decomposition temperature has decreased in presence of oxygen. The polarisation effect also change in presence of oxygen.

REFERENCES.

[1] Baruah G C, Talukdar C & Bora M N, Indian J Physics, 65B(6) (1991) 651
[2] Bora M N, Saikia D, Saikia R & Talukdar C , High temp High press 29 (1997) 683.
[3] Gllgg R E , Radiation research 6 (1957) 469-473.
[4] Florine A Blouin & Jett C Aurther, The effect of gamma radiation on cotton , Part V : Post irradiation reactions, Southern regional laboratory, New orleans, Louistad.
[5] McCubbin W L , J Polym. Sci. , 30 (1970) 181.
[6] Lews T J & Bowen P J, IEEE Trans, Electr. Insul. El. 19(3) (1984) 254.
[7] Abdel Moteleb N M, Naoumn M M, Shirouda H G & Rizk H A , J Polym. Sci. 20(3) (1982) 765.
[8] Bora M N , Baruah G C, Saikia D, Talukdar M & Talukdar C , 5th ATP conference Procedings, Seoul, Korea, (1998) 73.
[9] Bora M N , Baruah G C, & Talukdar C , Thermochimica acta (1993) 218.
[10] Bora M N & Talukdar M , Indian J Physics, 74 A (3) (2000) 263-265.
[11] Studies on the thermophysical properties of some organic complexases(Fibres) by X-ray diffraction and other physical methods, Ph.D. thesis, G C Baruah, (Gauhati University) 1991,pp 92
[12] Physical Chemistry of Polymers, A Tager, (Mir Publication, Moscow) 1978, pp.71.
[13] Talukdar M & Bora M N, Proceedings of 6th ATP Conference, India, (2001) 688-692.
[14] Solid State Physics, A J Dekker, (Mcmillan India Limited) 2000, pp.150.