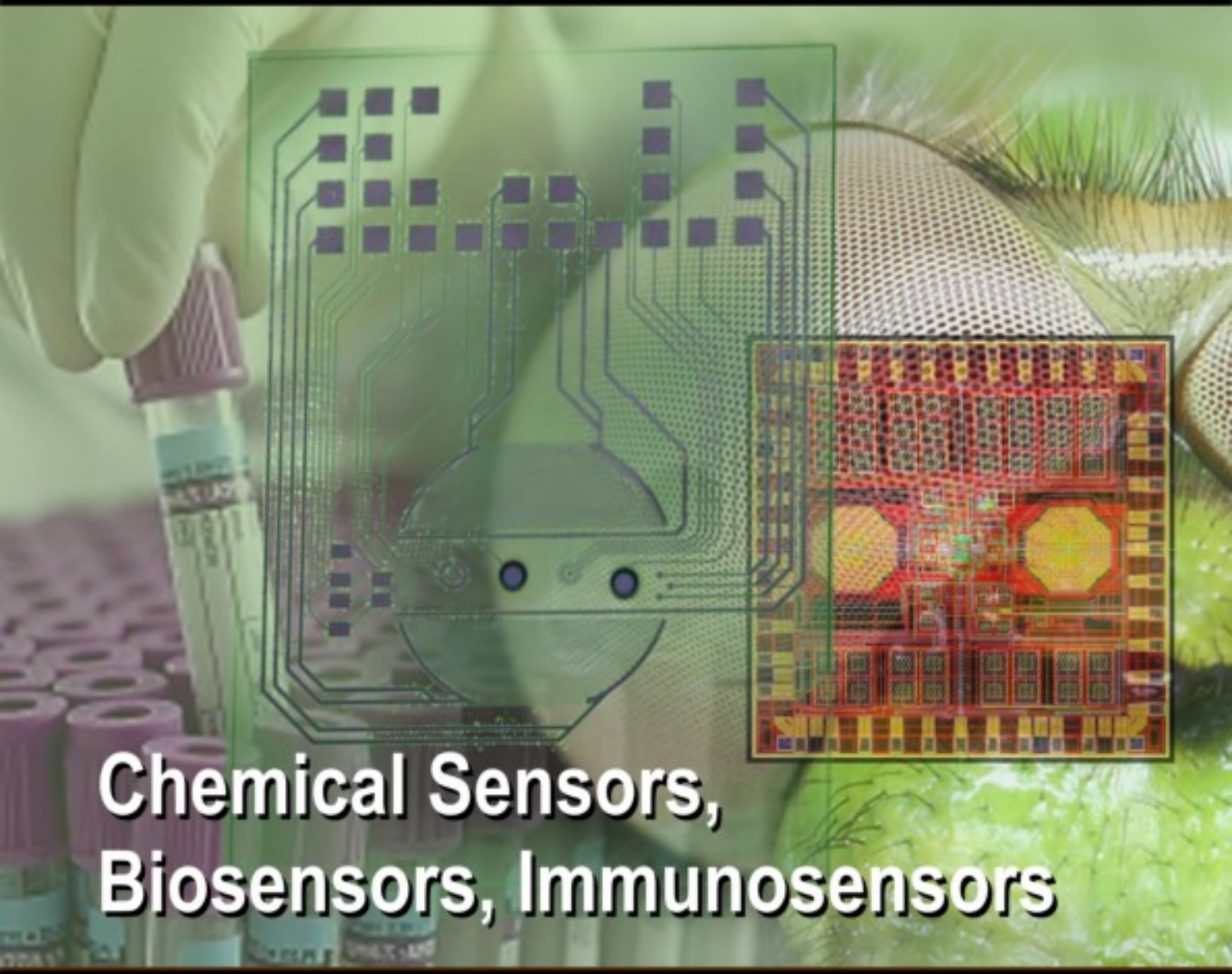
ISSN 1726-5479

SENSORS & TRANSDUCERS

vol. 113
2/10



Chemical Sensors, Biosensors, Immunosensors

International Frequency Sensor Association Publishing

IFSA

Sensors & Transducers

Volume 113, Issue 2, February 2010 | **www.sensorsportal.com** | **ISSN 1726-5479**

Sensors & Transducers Journal (ISSN 1726-5479) is a peer review international journal published monthly online by International Frequency Sensor Association (IFSA).
Available in electronic and on CD.

Sensors & Transducers Journal

Contents

Volume 113
Issue 2
February 2010

www.sensorsportal.com

ISSN 1726-5479

Research Articles

Authors are encouraged to submit article in MS Word (doc) and Acrobat (pdf) formats by e-mail: editor@sensorsportal.com
Please visit journal's webpage with preparation instructions: http://www.sensorsportal.com/HTML/DIGEST/Submition.htm

International Frequency Sensor Association (IFSA).

Sensors & Transducers Journal, Vol. 113, Issue 2, February 2010, pp. 167-176

www.sensorsportal.com

Sensors & Transducers

ISSN 1726-5479

http://www.sensorsportal.com

Electrical and Dielectric Properties of New Natural Cellulosic Fabric Grewia Teleflora

JAYARAMUDU J., [1]V. V. RAMANA C.H. and VARADARAJULU A.

Natural Fiber Laboratory, Department of Polymer Science & Technology, Sri Krishnadevaraya University, Anantapur – 515 055, Andhra Pradesh, India

[1] Scientific Instrumentation Laboratory, Department of Instrumentation, Sri Krishnadevaraya University, Anantapur – 515 055, Andhra Pradesh, India

E-mail: ramana6@gmail.com

Received: 31 January 2010 /Accepted: 19 February 2010 /Published: 26 February 2010

Abstract: This article deals with the electrical and dielectric properties of new natural cellulosic fabric Grewia tilifolia. Grewia tilifolia is a tree found in India, Sri Lanka, Tropical Africa, Burma and Nepal. The fabric samples of Grewia tilifolia were extracted from the bark of the tree. The electrical (AC conductivity & Impedance) and dielectric properties (Dielectric constant & dielectric loss) were measured as a function of frequency in the range from 1 kHz to 500 kHz, temperature in the range from 30 °C to 210 °C. Using an LCR Meter (HIOKI 3532-50 LCR Hi Tester, Koizumi, Japan) the electrical and dielectric properties were measured. Grewia tilifolia is a subtropical medicinal tree; the stem bark is widely used in traditional Indian medicines to cure pneumonia, bronchitis and urinary infectious disorders. *Copyright © 2010 IFSA.*

Keywords: Grewia tilifolia, AC conductivity, Impedance, Dielectric constant, Dielectric loss, LCR Meter, frequency and temperature

1. Introduction

Grewia tilifolia is a tree found in India, Sri Lanka, tropical Africa, Burma, and Nepal. Its bark, wood, fruits; leaves, and roots are used ethnomedically. The bark is used in Ayurvedic medicine to treat vitiated conditions of Pitta and Kapha, burning sensation, cough, skin diseases, wounds, ulcers, diarrhoea, seminal weakness, general debility, and hypertension [1–4]. The mucilage and the hot water

extract of the bark are used as an antidote for opium poisoning in human adults [5]. The stem bark is used to treat spermatorrhoea, in Bahraich, U.P., India, in human adults [6]. Several biological properties of the bark have been studied [7-8]. Fibers are the subject of study in relation to electrical and dielectric behaviour for a long time. Research on the electrical and dielectric properties of such materials has been carried out in many directions, which range from characterizing the fiber/fabric to the application of its dielectric properties in many diverse fields. The present paper is to summaries the most recent developments in the field of Efforts are being made to develop anticancer agents from Grewia tilifolia, in particular their application in biology and medicine.

1.1. Materials

The fabric extracted from the branches of the tree *Grewia tilifolia*, Sodium Hydroxide pellets (Merk specialities private limited, Mumbai, India) Benzene, Sodium Chlorite, Acetic acid, Sodium bisulphate and Ethanol S.d.fine-Chem Limited, Mumbai, India were the materials used in the present work. The new natural fabric Grewia tilifolia tree is shown in Fig. 1.

Fig. 1. New Natural Cellulosic Fabric Grewia tilifolia tree.

1.2. Extraction of the Fabric from the Tree

The fabric samples of *Grewia tilifolia* were extracted from the bark of the tree. They were kept in water for a week to remove the dirt and other foreign material. They were then thoroughly washed and dried in the sun for a week. Some of the samples were treated with 5% NaOH solution (by weight) at a maximum temperature of 30 ºC and a hold time of 45 min and after treatment, the fabrics were thoroughly washed and then dried at 80 ºC for 24 h and stored. The samples were also redried before analysis. This uniaxial fabric was analyzed by Chemical, Fourier transform infrared spectroscopy, Thermogravimetric analysis, X-ray diffraction, Scanning electron microscopy and polarized optical microscopic techniques are published [9].

1.3. Impedance

The ratio of the voltage phasor to the electric current phasor. A phasor is a constant complex number, usually expressed in exponential form, representing the complex amplitude (magnitude and phase) of a sinusoidal function of time. Phasors are used by electrical engineers to simplify computations involving sinusoids, where they can often reduce a differential equation problem to an algebraic one.

1.4. AC Conductivity

AC Conductivity is one of the studies done on solids in order to characterize the bulk resistance of the crystalline sample. This study also gives information on electrical properties of materials and their interface with electronically conducting electrodes.

1.5. Dielectric Constant

The dielectric constant is an essential piece of information when designing capacitors, and in other circumstances where a material might be expected to introduce capacitance into a circuit. If a material with a high dielectric constant is placed in an electric field, the magnitude of that field will be measurably reduced within the volume of the dielectric. This fact is commonly used to increase the capacitance of a particular capacitor design.

1.6. Dielectric Loss

Dielectric loss due to movement or rotation of the atoms or molecules in an alternating electric field. A loss of energy that eventually produces a rise in temperature of a dielectric placed in an alternating electrical field.

Dielectric materials have many important functions in the microelectronics industry. New packaging technology requires substrates with low permittivity, interconnections made of high-conductivity metals, high wiring density, and embedded passive circuit elements.

2. Experimental

2.1. Electrical and Dielectric Properties of Fiber Measurements

The experimental set-up for the measurement of electrical and dielectric properties of new natural cellulosic fabric Grewia tilifolia is shown in Fig. 2. A commercial digital LCR meter (HIOKI 3532-50 LCR Hi Tester, Koizumi, Japan) was used to measure the electrical properties (Impedance & AC Conductivity) and dielectric properties (capacitance and dissipation factor (D)) [10].

The fabric samples were measured as a function of frequency in the range from 1 kHz to 500 kHz, temperature in the range from 30 °C to 210 °C. Impedance, X, RS, capacitance and dissipation factor were measured with the sample in the cell.

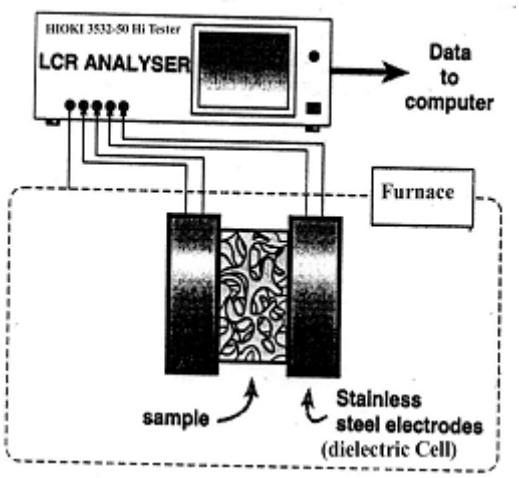


Fig. 2. Experimental set-up for the determination of electrical and dielectric properties of Grewia tilifolia fiber/fabric.

The dielectric constant (ε′) of the samples are calculated using the formula (1)

$$\varepsilon' = C_p \, d / \varepsilon_0 \, A, \tag{1}$$

where:
C_p = Parallel capacitance of the cell with the sample;
d = Thickness of the sample;
$\varepsilon_0 = 8.854 \text{ X } 10^{-12}$ F/m;
A = Area of the sample.

The AC conductivity (σ_{ac}) of the samples are calculated using the formula (2)

$$\sigma_{ac} = [X^2 / (X^2 + RS^2)] * [t/A] , \tag{2}$$

where:
X = Real;
RS = Series Resistance;
T = Thickness of the sample;
A = Area of the sample.

3. Results and Discussion

The graphical results of electrical (Impedance & AC Conductivity) and dielectric (Dielectric constant & Dielectric loss) properties of Grewia tilifolia fabric samples in untreated / treated condition are presented in Figs. 3, 4, 5, 6, 7, 8 9, and 10 respectively. The parameters were determined at a frequency range of 1 KHz to 500 KHz at variable temperature range of 30 °C to 210 °C.

The Impedance for untreated / treated Grewia tilifolia fabric was determined at a frequency range of 1 kHz to 500 kHz at variable temperature range of 30 °C to 210 °C. The graphs are drawn between temperature verses impedance for untreated / treated fabric samples in Figs. 3 and 4 respectively. From Fig. 4, we conclude that there is an electronic polarization at frequencies 1 kHz, 5 kHz and 10 kHz at 75 °C temperature for treated, because in treated the lignin was removed. The AC conductivity for

untreated / treated Grewia tilifolia fabric was determined at a frequency range of 1 kHz to 500 kHz at variable temperature range of 30 °C to 210 °C. The graphs are drawn between temperature verses AC Conductivity for untreated / treated fabric samples in Fig. 5 and 6 respectively. From Fig. 6, we conclude that lattice is decreased and large polaron hopping at frequency 500 kHz at 70 °C temperature for treated, because in treated the hemicellulose decreased. The Dielectric Constant for untreated / treated Grewia tilifolia fabric was determined at a frequency range of 1 kHz to 500 kHz at variable temperature range of 30 °C to 210 °C. The graphs are drawn between temperature verses dielectric constant for untreated / treated fabric samples in Figs. 7 and 8 respectively.

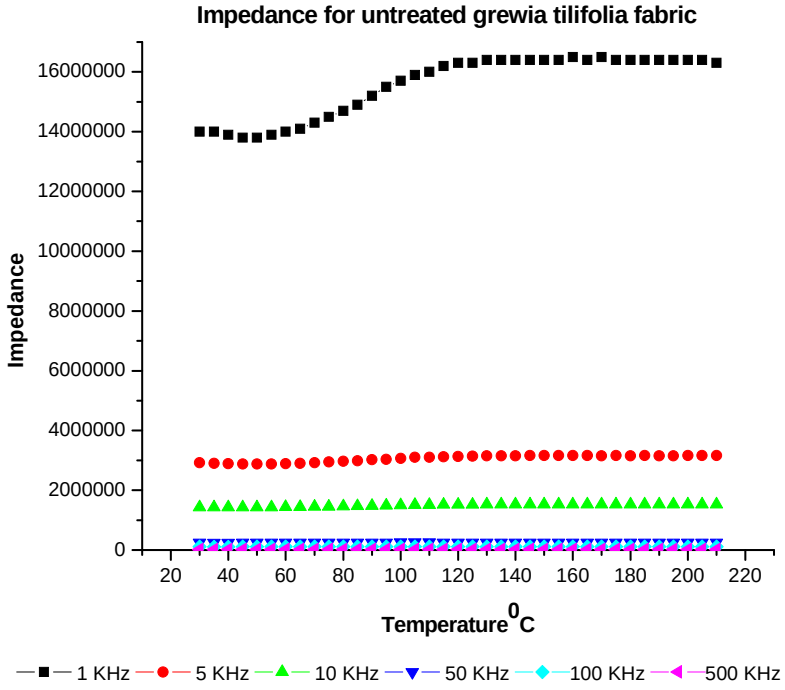


Fig. 3. Impedance for untreated Grewia tilifolia fabric.

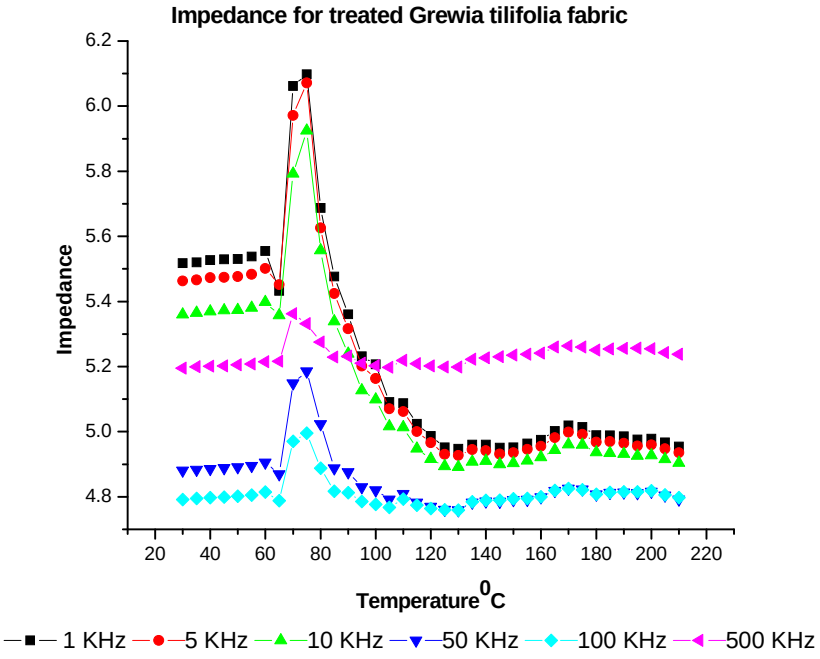


Fig. 4. Impedance for treated Grewia tilifolia fabric.

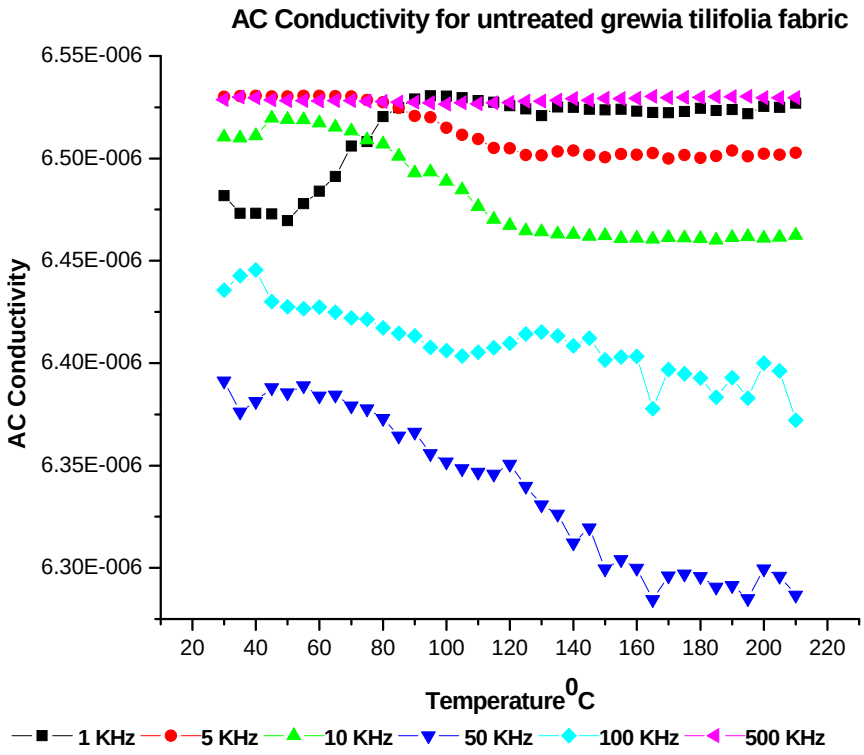


Fig. 5. AC Conductivity for untreated Grewia tilifolia fabric.

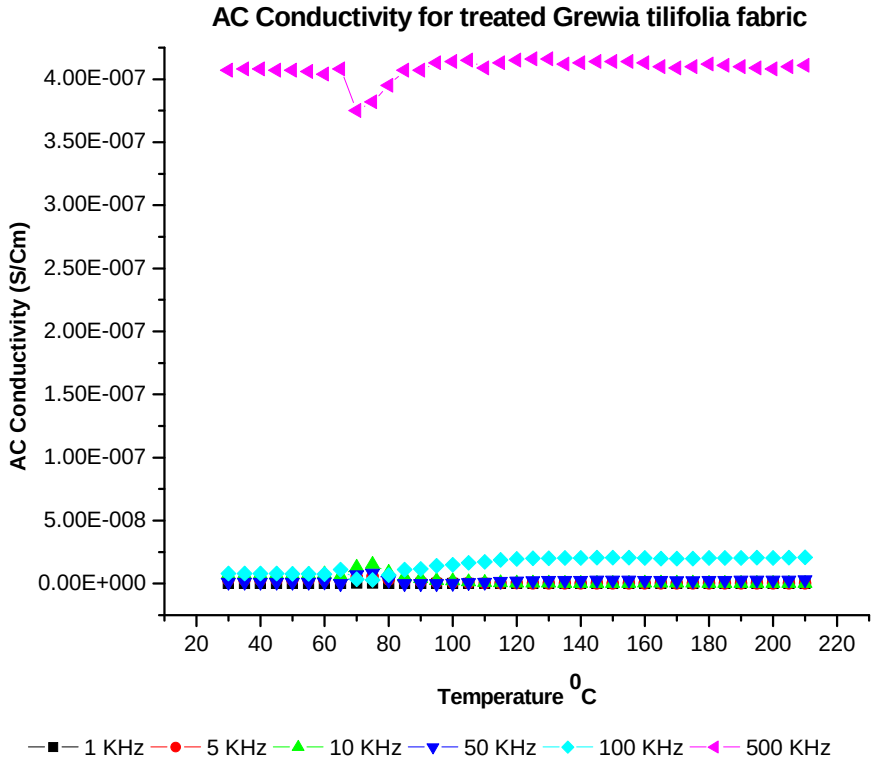


Fig. 6. AC Conductivity for treated Grewia tilifolia fabric.

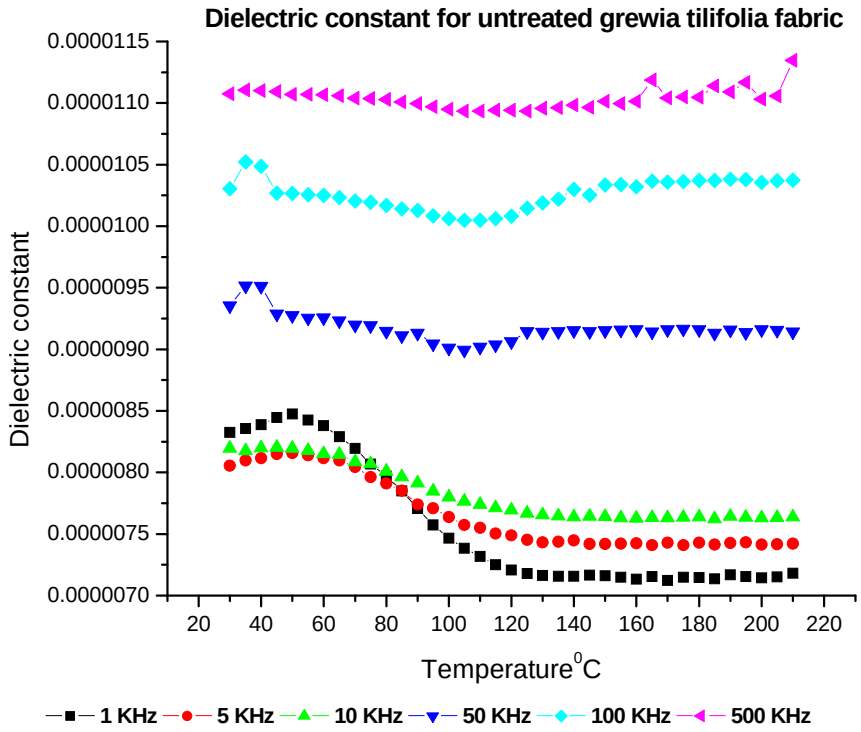


Fig. 7. Dielectric constant for untreated Grewia tilifolia fabric.

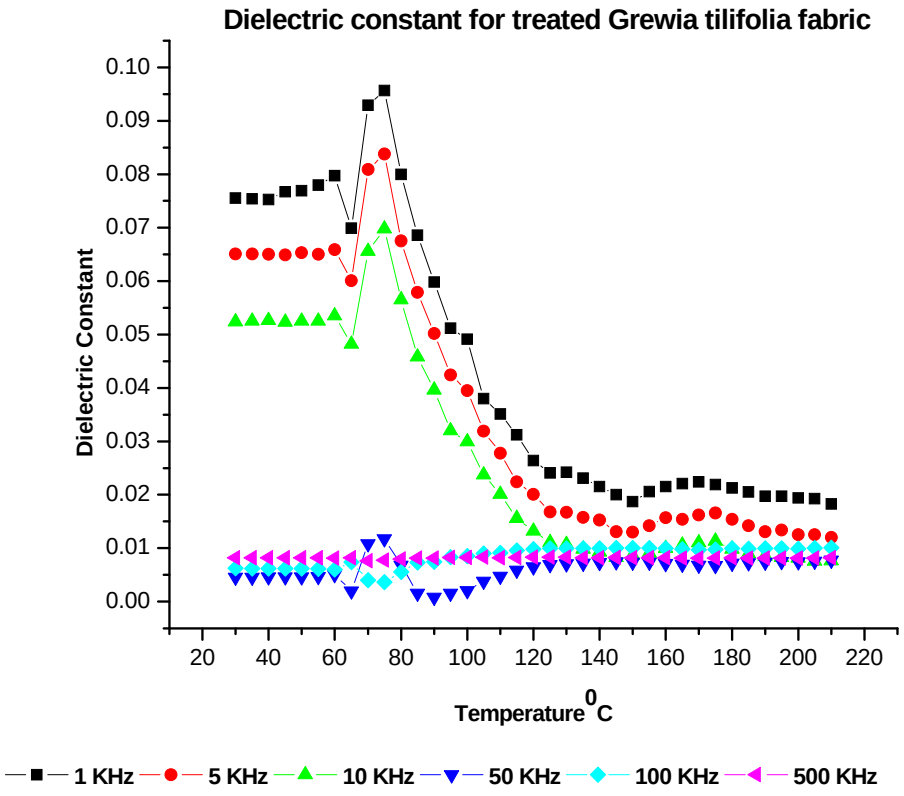


Fig. 8. Dielectric constant for treated Grewia tilifolia fabric.

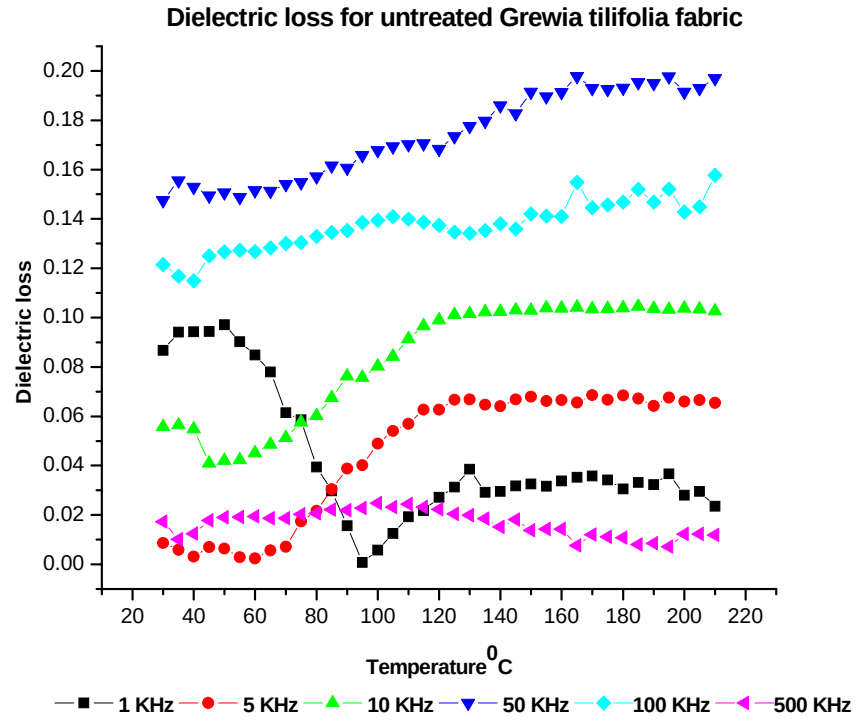


Fig. 9. Dielectric loss for untreated Grewia tilifolia fabric.

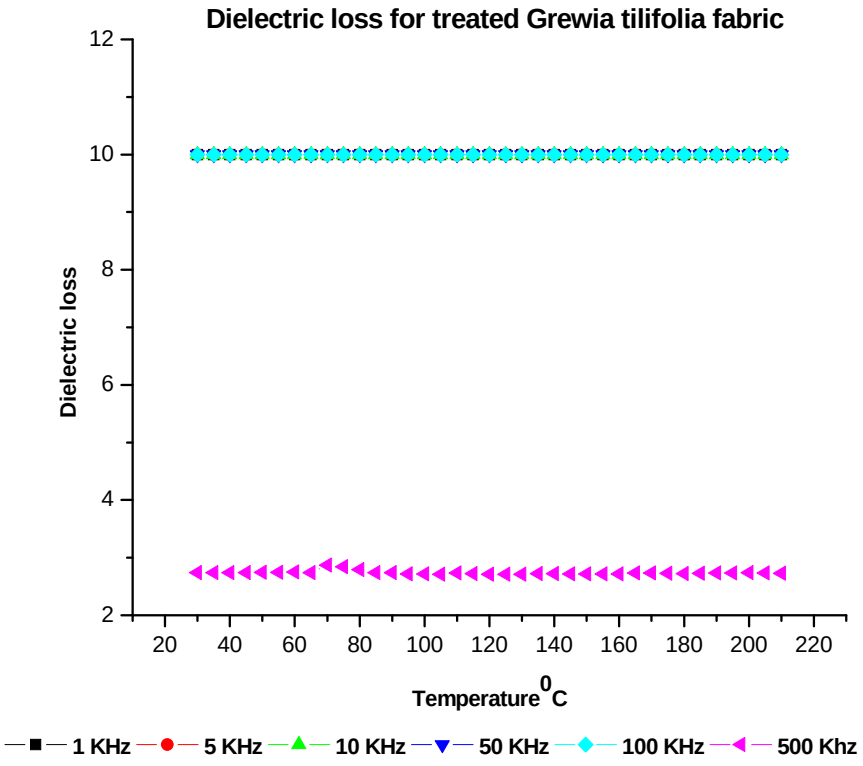


Fig. 10. Dielectric loss for treated Grewia tilifolia fabric.

From Fig. 8, we conclude that the fabric is frequency dependent. The molecules decreased with increase in temperature, leading to the decrease in dielectric constant for treated. The Dielectric Loss for untreated / treated Grewia tilifolia fabric was determined at a frequency range of 1 kHz to 500 kHz at variable temperature range of 30 °C to 210 °C. The graphs are drawn between temperature

verses dielectric loss for untreated / treated fabric samples in Figs. 9 and 10 respectively. From Fig. 10, we conclude that there is a constant dielectric loss at frequency 100 kHz for entire temperature range for treated, because in treated the lignin and hemicellulose was removed.

The Impedance, AC conductivity, Dielectric constant and Dielectric loss for untreated Grewia tilifolia fabric are shown in Figs. 3, 5, 7 and 9 respectively. The untreated Grewia tilifolia fabric contains lignin and hemicellulose.

4. Conclusion

The results of electrical and dielectric properties of Grewia tilifolia fabric for untreated / treated determined at a frequency range of 1 kHz to 500 kHz at variable temperature range of 30 °C to 210 °C using LCR meter (HIOKI 3532-50 LCR Hi Tester, Koizumi, Japan). When lignin and hemicellulose removed from the fabric there is an electronic polarization, lattice decrease and large polaron hopping occurred in electrical properties and frequency dependent, the molecules decreased with increase in temperature, leading to the decrease in dielectric constant and constant dielectric loss at frequency 100 KHz for entire temperature range appeared in dielectric properties. The present paper constitutes a step towards the most recent developments in the field of Efforts are being made to develop anticancer agents from Grewia tilifolia, in particular their application in biology and medicine.

Acknowledgements

This work was supported by University Grants Commission (UGC) of India sponsored Major Research Project. No 33-397/ 2007 (SR).

References

[1]. S. Raghunathaiyar, Indian Medicinal Plants, *Orient Longman*, Hyderabad, Vol. 3, 1996, pp. 104–105.
[2]. Anon., The Wealth of India, *Council of Scientific and Industrial Research, CSIR*, New Delhi, Vol. 4, 1987, pp. 264–266.
[3]. L. B. Asolkar, K. K. Kakkar, O. J. Chakre, Second Supplement of Glossary of Indian Medicinal Plants with Active Principles, Part-I, *Publication and Information Directorate*, New Delhi, 1992, pp. 339–340.
[4]. J. F. Caius, J. Bombay, *Nat. Hist. Soc*., 44, 1943, p. 92.
[5]. R. N. Chopra, Indigenous Drugs of India – Their Medicinal and Economic Aspects, *The Art Press*, Calcutta, 1933, p. 550.
[6]. V. K. Singh, Z. A. Ali, M. K. Siddiqui, *Fitoterapia*, 67, 1996, pp. 65–76.
[7]. V. P. Komboj, B. S. Setty, V. M. Kanna, *Contraception*, 15, 1977, pp. 601–610.
[8]. B. N. Dhawan, G. K. Patnaik, R. P. Rastogi, K. K. Singh, *Indian J. Exp. Biol*., 15, 1977, pp. 208–219.
[9]. J. Jayaramudu, B. R. Guduri, A. V. Rajulu, Characterization of new natural cellulosic fabric Grewia tilifolia, *Carbohydrate Polymers (Journal)*, (In Press).
[10]. LCR Meter (HIOKI 3532-50 LCR Hi Tester, Koizumi, Japan).

Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because it is an open access, peer review international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per annual by International Frequency Association (IFSA). In additional, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc.

Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

- Physical, chemical and biosensors;
- Digital, frequency, period, duty-cycle, time interval, PWM, pulse number output sensors and transducers;
- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

Submission of papers

Articles should be written in English. Authors are invited to submit by e-mail editor@sensorsportal.com 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example and template of manuscript are available from the journal's webpage: http://www.sensorsportal.com/HTML/DIGEST/Submition.htm Authors must follow the instructions strictly when submitting their manuscripts.

Advertising Information

Advertising orders and enquires may be sent to sales@sensorsportal.com Please download also our media kit: http://www.sensorsportal.com/DOWNLOADS/Media_Kit_2009.pdf

Subscription 2010 is open!
SUBSCRIBE TODAY!

Sensors & Transducers Journal provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes reviews, regular research and application specific papers and short notes. This peer reviewed international journal is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List (ICV=6.31 at the end of 2008), Open J-Gate, Google Scholar, Scirus, etc.

Topics of Interest

Include, but are not restricted to:
Physical, chemical and biosensors
Digital, frequency, period, duty-cycle, pulse number output sensors and transducers
Theory, principles, effects, design, standardization and modelling
Smart sensors and systems
Sensor instrumentation
Virtual instruments
Sensors interfaces, buses and networks
Signal processing
Technologies and materials
Nanosensors
Microsystems
Applications

2008
e-Impact Factor
205.767

IFSA
www.sensorsportal.com

editor@sensorsportal.com
http://www.sensorsportal.com/HTML/DIGEST/Journal_Subscription_2010.htm

www.sensorsportal.com