ISSN: 2321-7782 (Online)
Volume 2, Issue 10, October 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Impedance Analysis of Mouth Cancer Patient's Saliva

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Abstract: Real components are never ideal resistors, capacitors or inductors because of parasitic effects arising from their construction. It is useful to model a real component as an appropriate combination of ideal resistance, capacitance and inductance. A real inductor at a frequency below its resonant frequency may be modeled as a pure inductor with a series resistance; a real resistor may be modeled either as a pure resistor with a series inductance or by a pure resistor with a parallel capacitance; a capacitor is most commonly modeled as a pure capacitor with a series resistance. Impedance analysis of mouth cancer patient's, normal person's and tobacco-gutaka chewing person's saliva has been carried out using Newtons4th Ltd. PSM1700 series analyzers.

Keywords: Impedance analyzer, capacitance, impedance, cancer, saliva.

I. INTRODUCTION

The dielectric study using LCR meter is based on impedance measurement basics. Impedance is an important parameter used to characterize electronic circuits, components and materials used to make components. Impedance (Z) is generally defined as the total opposition a device, a circuit offers to the flow of an alternating current (AC) at a given frequency and is represented as a complex quantity $Z = R + j\ X = |\ Z\ |\ < \theta$, where $R = |Z\ | \cos\theta$, $X = |\ Z\ | \sin\theta$. Thus real part of impedance vector is a resistance R and imaginary part is the reactance X; the inductive reactance $X_L = 2\pi\ f\ L$ or capacitive reactance $X_C = 1/2\pi\ f\ C$.

Many modern impedance measuring instruments measure the real and imaginary parts of an impedance vector and then convert them to the desired parameter. It is necessary to connect a unknown component, circuit or material to the instrument. The measured impedance value of component depends on several measurement conditions, such as frequency, test signal level, DC bias, temperature and so on.

There are many measurement methods to choose from when measuring impedance, each of which has advantages and disadvantages. The commonly used methods are bridge method, resonant method, I-V method, RF I-V method, network analysis method and auto balancing bridge method etc. The bridge method has advantage of high accuracy, wide frequency coverage using different types of bridges and low cost and disadvantages of narrow frequency coverage with a single instrument or higher frequency ranges not available etc.

II. EXPERIMENTAL

LCR meter is to be used to measure capacitance of the saliva samples. The dielectric constant or relative permitivity can be obtained using $k = C / Co$, where C is the capacitance of the saliva sample and Co is the capacitance with air as dielectric. Using relation $C = \varepsilon\ \varepsilon o\ A/d$ i.e. $\varepsilon = C\ d / \varepsilon o\ A$ and using minimum and maximum frequencies available with LCR meter, the static permitivity εs and permitivity at high frequency $\varepsilon\infty$ can be calculated. The dielectric constant is function of frequency and written as complex quantity known as complex permitivity $\varepsilon^*(\omega) = \varepsilon' - j\ \varepsilon''$ where ε' is dielectric constant and ε'' is dielectric loss. Therefore ε', ε'' can be obtain over the operating range of frequency of the instrument.

III. Data Analysis

The experimental values of impedances were used to obtain complex permittivity spectra $\varepsilon^*(\omega)$ by using the bilinear calibration method. A sample $\varepsilon^*(\omega)$ spectrum for saliva of cancer patient and normal person is shown in figure 1. The Cole-Cole plot for saliva of cancer patient and normal person is shown in figure 2.

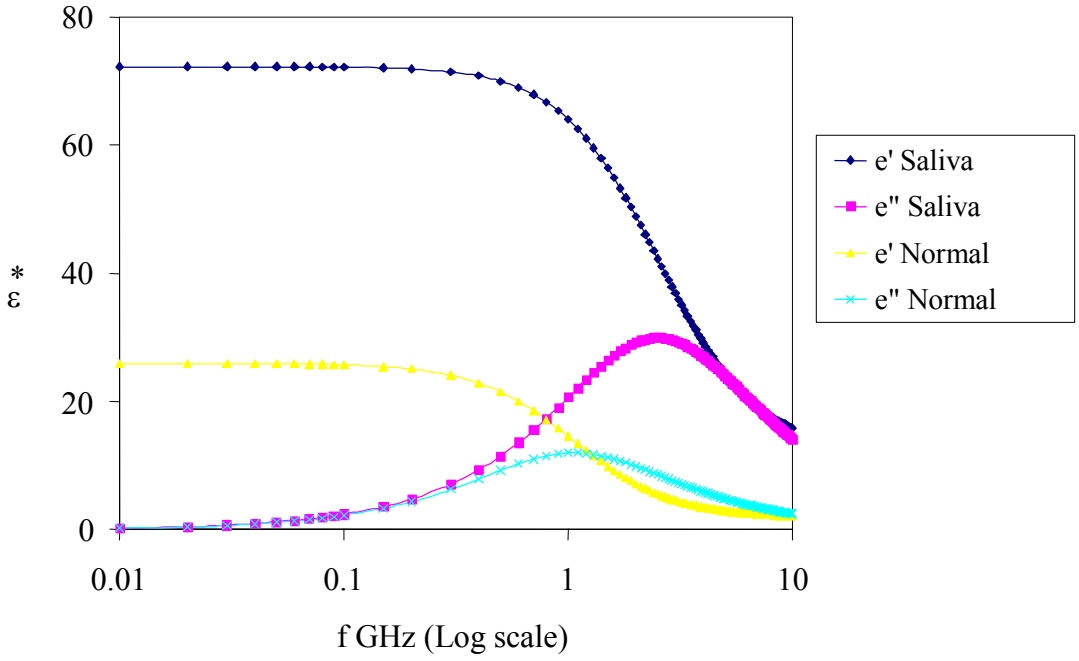

Fig.1: $\varepsilon^*(\omega)$ spectrum of Saliva-Normal

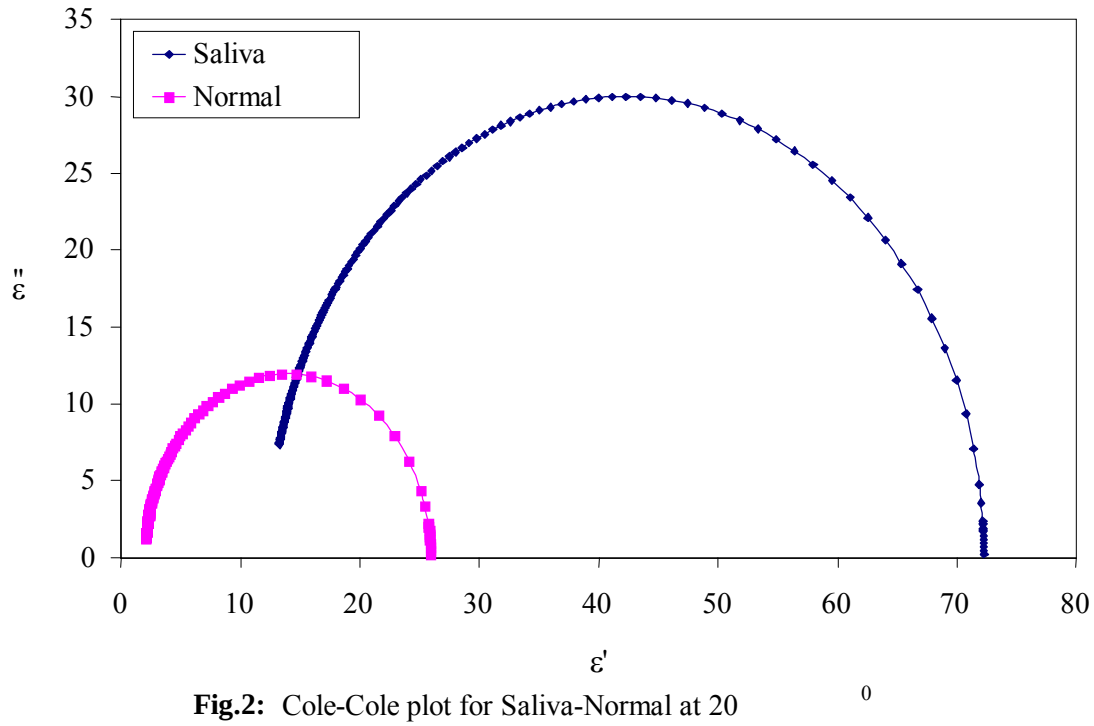

Fig.2: Cole-Cole plot for Saliva-Normal at 20

IV. Conclusion

The interpretation of dielectric behavior of saliva in terms of its molecular structure is a scientific objective. The study is useful to understand the physical phenomenon that occurs in dielectric that is placed in alternating field and to find the parameters of the dielectric, which quantitatively determine their electrical properties.

V. Review of Research and Development in the Subject

1. International Status: Comparison of multifrequency bioelectrical impedance was studied by G. Sun; C.R. French et'al.
2. National Status: Bioelectrical impedance phase angle in clinical practice was studied by D. Gupta, C.G. Lis et.al
3. Significance of the study: Bioelectrical impedance analysis, which involves measurement of the impedance of saliva of mouth cancer patient, normal person and tobacco, gutaka chewing person to an alternating current, may be of value in physical, biological, engineering and medical field.

Acknowledgement

The author is greatly obliged to BCUD, Savitribai Phule Pune University Pune for the financial support through Minor Research Project Scheme. The author wishes to thank Dr. S. C. Mehrotra, Dr. J. B. Shinde and Prin. P. A. Lawande for valuable guidance and encouragement.

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