Short Communication

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DIELECTRIC CONDUCTIVITY OF SHELLAC AND ITS MIXTURE WITH ROCHELLE SALT, POWDERED MICA AND WOOD DUST AT 9.44 GHZ

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INTRODUCTION

Lac is a resinous secretion of a tiny red insect *Luccifer lacca* on the twigs and branchlets of a number of trees which acts as the host. There are various form of lac, such as row lac, seed lac, shellac, bleached lac, dewaxed lac, dewaxed shellac, lacwax and sealing wax. The present communication reports on the dielectric hebaviour of lac at 9.44 GHz, such as, the dielectric conductivity δ, index of absorption k and index of refraction n of different varieties of lac and shellac mixture with rochelle salt, powdered mica and wood dust. To the authors knowledge, no previous data on the dielectric measurements of these mixtures of shellac have been published.

EXPERIMENTAL

The samples were procured from the BCSIR laboratories (Rajshahi), Bangladesh. The dielectric measurements (i.e. dielectric constant ϵ' and tan δ) were carried out in the X-band of microwave frequency 9.44 GHz and adopting the principle of reflection described by Von Hippel[1]. All the measurments were made in air at room temperature and the accuracy of measurments were estimated to be 5%.

The dielectric conductivity $\delta = \omega \epsilon_0 \epsilon''$ was calculated using the relation $\epsilon'' = \epsilon' \tan \delta$, where ϵ_0 is the permittivity of free space having a vlaue of 8.854 pF m^{-1}, ϵ'' is the loss factor at an angular frequency w, tanδ is the loss tangent. The index of absorption k (which is the attenuation per radian) and the index of refraction n are obtained using the following relations [1].

$$k = \left[\frac{\sqrt{1+\tan\delta} - 1}{\sqrt{1+\tan\delta} + 1}\right]^{1/2} \quad \text{..........(1)}$$

$$\text{and } n = \left[\frac{\epsilon'}{2}\{\sqrt{(1+\tan^2\delta)}+1\}\right]^{1/2} \quad \text{..........(2)}$$

RESULTS AND DISCUSSION

The values of δ, k and n of different varieties of lac are summerized in Table 1, in which the values are obtained from the averages of several measurments on each individual specimens. Table. 1 shows that there is a systematic increase in microwave absorption in all samples (except sealing wax) as their dielectric conductivity increases. In these measured lac samples (Table.1) in which sealing wax has the maximum conductivity and index of refraction but minimum absorption of microwave. This property of sealing wax may be useful in the high frequency measureing instruments.

Table 1. Dielectric and optical data of different varieties of Lac at 9.44 GHz at 293°K.

Name of the Lac samples	Dielectric conductivity (Ohm^{-1} m^{-1})	Index of absorption	Index of refraction
Seed Lac	0.028	0.012	1.66
Lac Wax	0.033	0.018	1.49
Shellac	0.045	0.019	1.68
Raw Lac	0.047	0.020	1.64
Dewaxed Lac	0.092	0.036	1.7
Bleached Lac	0.099	0.043	1.62
Dewaxed Shellac	0.116	0.054	1.7
Sealing Wax	0.177	0.018	1.8

The variation of dielectric conductivity, index of absorption and index of refraction as a function of mixing proportion for the mixture of shellac and rochelle salt; the mixture of shellac and powerded mica; and the mixture of shellac and wood dust are shown in the Fig. 1,2, and 3 respectively. These results showed that the values of δ, k and n for the mixtures of shellac are inreased with the increasing concentrations of rochelle salt and powdered mica,

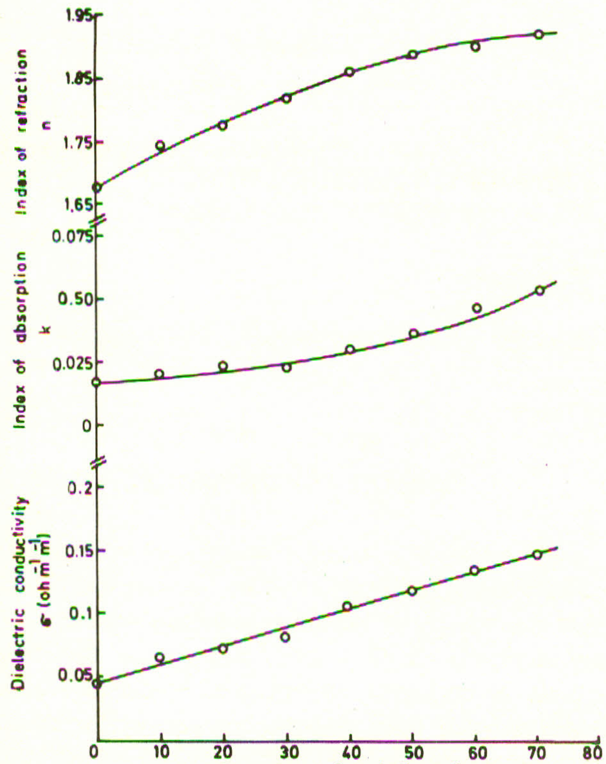

Fig. 1. Variation of the dielectric conductivity, index of absorption and index of refraction of mixture shellac as a function of mixing proportion by weight of rochelle salt.

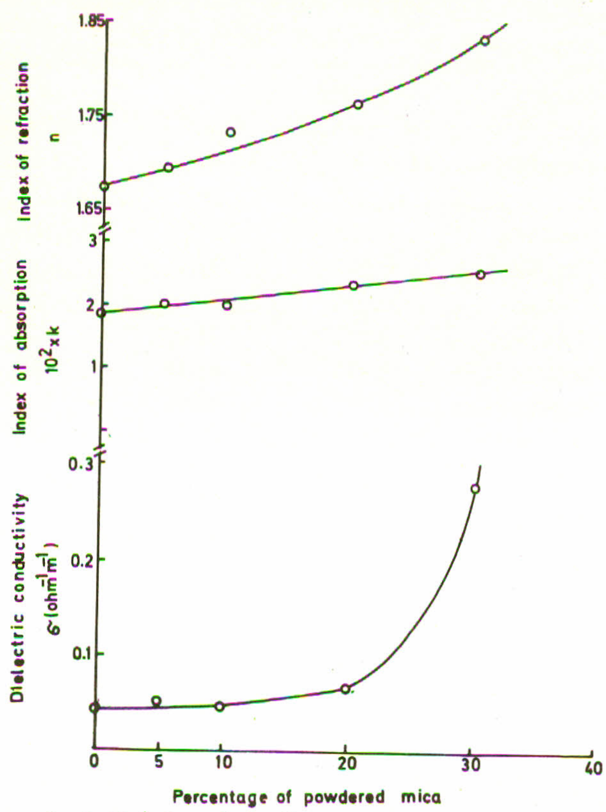

Fig. 2. Variation of the dielectric conductivity, index of absorption and index of refraction of mixture shellac as a function of mixing proportion by weight of powerded mica.

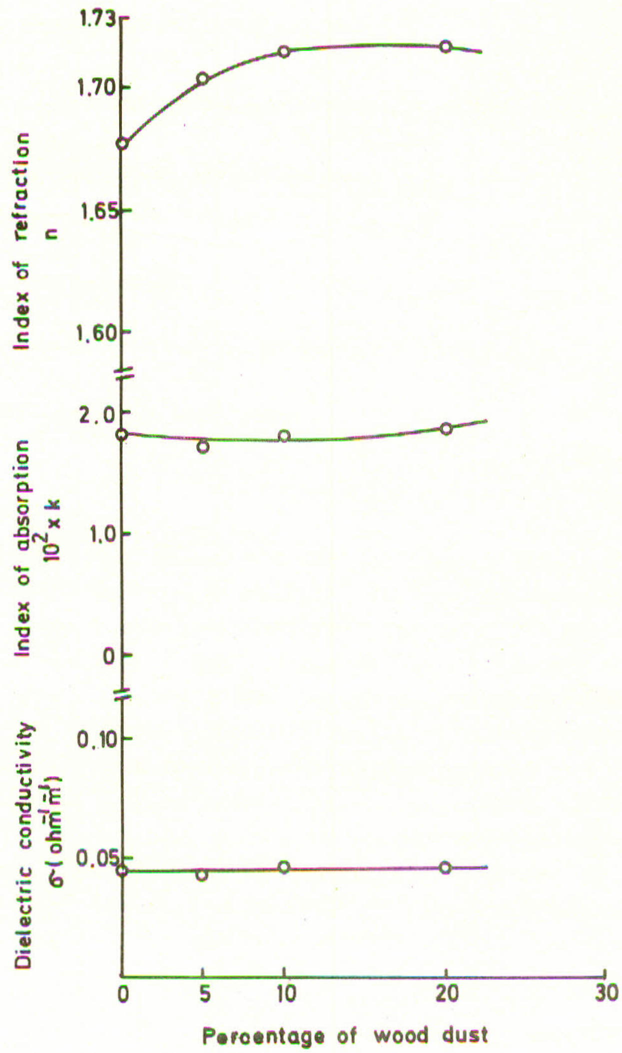

Fig. 3. Variation of the dielectric conductivity, index of absorption and index of refraction of mixture shellac as a function of mixing proportion by weight of wood dust.

where as with the wood dust these values are almost constant except for index of refraction. The dielectric constant or rochelle salt and mica at microwave frequency are about 8 and 5 respectively, where as the dielectric constants of mango dust and shellac at 3 cm wavelength are 2.006 [2] and 2.8203 [3] respectively. Since the dielectric conductivity and the index of refraction are directly related to the dielectric constant, therefore the dielectric conductivity of the mixture will rise towards the dielectric constant of the higher concentration component of the mixture (as in the Figs. 1 and 2) because the dielectric constant of a mixture will follow the Debye equation [4]. The index of refraction of the mixture of shellac with wood dust does not obey the usual rule. The reason for this behaviour is not yet fully understood.

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