Introduction

In this report we present the preliminary ac dielectric and magnetic studies of a biological material, *Tillandsia usneoides*, commonly known as Spanish moss, as reported elsewhere [1]. Spanish moss is an epiphyte, i.e., it grows on other plants or trees or even telephone wires, without being parasitic and without any obvious source of nutrition and is widely found from Virginia to Florida and Texas. To our knowledge, there has been no systematic effort to study this interesting material, except for the trace metal analysis [2,3]. Thus a deeper understanding of this readily available material could lead to new possible ways to exploit its natural energy processes.

Experimental

Dielectric response data were obtained with a standard ac bridge from 10 to 400 kHz. Magnetization data were collected on Quantum Design SQUID and PPMS instruments at the NHMFL. X-band (~9.5 GHz) EPR data were collected on Bruker Elexsys 680 at NHMFL.

Results and Discussion

Figure 1 shows the temperature dependence of ~9.5 GHz EPR spectra. The peak centered at $g \approx 1.996$ with six-line structure is typical of a Mn$^{2+}$ ion. The spacing of about 100 G corresponds to the hyperfine splitting of $^{55}$Mn for a dilute system of Mn$^{2+}$ ions. The broad peak in the middle can be tentatively assigned to Fe$^{3+}$ ions. A large shift of this peak’s position to lower field is observed as temperature is decreased. Furthermore, the magnetization measurements show a diamagnetic behavior in 6 – 300 K temperature range and a Curie tail below 6 K. The ac dielectric response of Spanish moss at the frequencies of 10, 100, 200 and 400 kHz is shown in Figure 2. In a simple model, for a given frequency, the observed dissipation maximum implies that at the peak temperature the time scale of the system’s dielectric fluctuations coincides with the time period of the applied frequency. It can also be seen that as the frequency increases, the temperature corresponding to the dissipation maximum shifts to higher temperatures. The energy barrier can then be obtained by plotting $\ln \nu$ vs $1/T$. For Spanish moss, a barrier of $0.6 \pm 0.1$ eV was deduced, which is quite reasonable for dipole fluctuations.

Conclusions

In summary, Spanish moss has a dielectric response characteristic of a water containing dipolar material, exhibits strong Manganese hyperfine line and an anomalous iron line.

References


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