SHORT COMMUNICATION

MEASUREMENT OF DIELECTRIC CONSTANT ε' of $Fe_{73.5}$-Cu_1- Ta_3-$Si_{13.5}$-B_9 BIPHASE METALLIC GLASS

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The investigation of dielectric constant *ε*' is important for its many possible applications in a wide range of frequency and temperature. Oxide glasses containing transition metal ions (TMI) came to focus for many studies. Many investigations have been carried out on oxide glasses. The studied sample is a metallic glass in *Fe-Si-B* system. It is developed in the form of ribbon by single roller melt-spinning technique in air. In its study, dielectric constant, *ε*' of as cast and annealed samples was measured as a function of frequency (1MHz ~ 1GHz) using Agilent Impedance Analyzer. The samples were annealed for 15 minutes at 150, 250 and 350^0C. Fig. 1 represents frequency dependence of dielectric constant, *ε*' in logarithmic scale and trend is seen to be nearly same for both as cast and annealed samples. Dielectric constant, *ε*' is found to remain almost constant up to 4 MHz, which we can call limiting frequency. Up to 10 MHz, it decreases at high rate and afterwards remains constant. This decrease in dielectric constant, *ε*' with frequency in the range 4 ~ 10 MHz can be attributed to multicomponent contributions to its polarizability as explained by Sharaf El-Deen *et al.*[(1)] As the frequency is increased ionic and orientation sources of polarizability decreases, and finally disappears due to inertia of grains, embedded in amorphous matrix. Since electronic polarizability, α_e is the only process which is sufficiently rapid to follow alternating fields, its contribution is only

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present in dielectric constant, ε' after 10 MHz. Furthermore, it is found to increase with annealed temperature T_a at constant frequency as evident from the variation of ε' with T_a as shown in Fig. 2. This increasing trend of dielectric constant, ε' resulted from structural relaxation because of heat treatment,[2] which facilitates to increase orientational and electronic contributions to polarizability. Thus, the strong dependency of dielectric constant, ε' both on frequency and temperature is interdependent. All three components of polarization play their role to its polarizability in lower range of frequencies (< 10 MHz). The orientational contribution ceases and only the electronic contribution is present at frequencies (>10 MHz). The contribution from orientational polarizability is negligible because molecular dipoles are in frozen state at room temperature. But at high temperature, polarization resulting from molecular dipoles becomes significant due to structural relaxation and adds to other contributions of polarizability. 1 - 4 MHz, 4 - 10 MHz and 10 MHz - 1 GHz are the three distinct regions, evident from its frequency dependence, which may make it useful in switching and sensor devices.

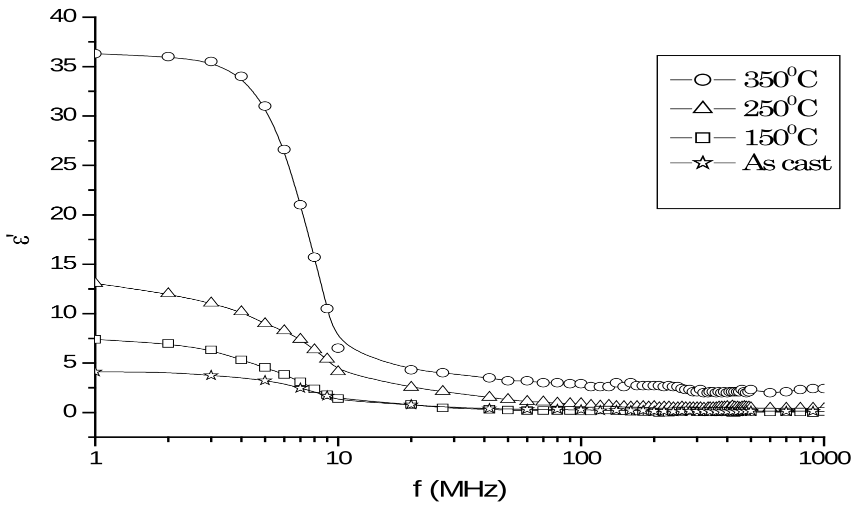

Fig. 1. Dielectric constant ε' vs the frequency *f* for all the samples.

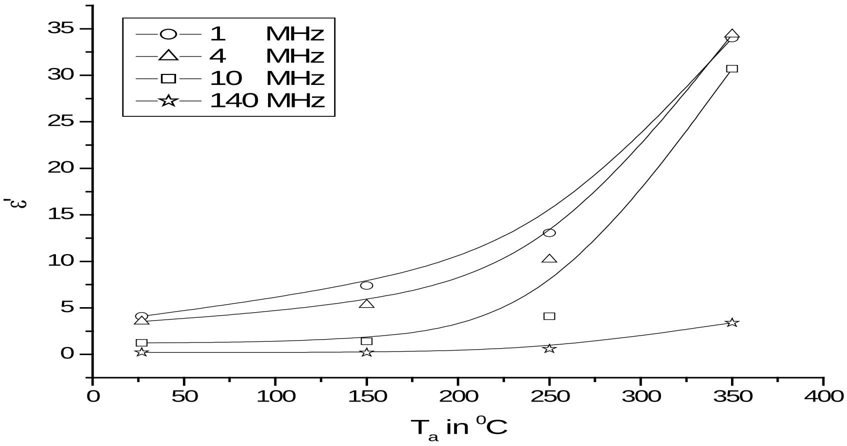

Fig. 2. Dielectric constant ε’ vs annealing temperature T_a for all the samples.

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