Dielectric properties of Barium Crystal Glass

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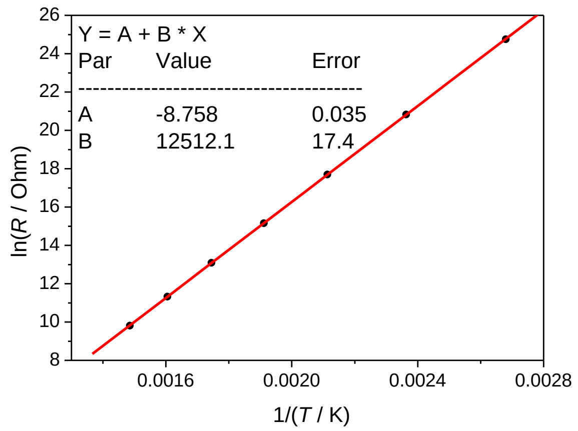
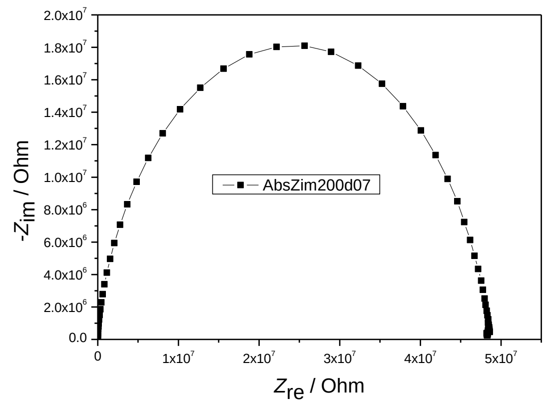
ABSTRACT

Complex impedance spetroscopy is flexible tool for simultaneous electrical and dielectrical characterization of materials. This powerful technique has been widely used to characterize the dielectric behaviour of single crystal, polycrystalline and amorphous materials [1-4].
In a typical EIS experiment, the complex electrical impedance of a sample is measured as a function of frequency over a wide frequency range – typically several orders of magnitude. From an experimental point of view, performing impedance analysis at frequencies below some MHz is a straightforward procedure, but the physical interpretation of experimental data is quite often rather complex. A frequently used method to analyze impedance data is modelling of the impedance spectra by an appropriate equivalent circuit. Graphically the experimental data are often plotted as the so-called Nyquist diagram, i.e. a plot of the negative imaginary part of the impedance –Z′′ versus its real part Z′[5]. When measurements are carried out at different temperatures, it is possible to determine the activation energies of the conduction and dielectric relaxation processes.
The temperature dependence of the impedance spectra of the barium crystal glass was studied at temperatures (50, 100, 150, 200, 250, 300, 350, and 400)°C, in the frequency range from 1mHz to 1 MHz. Samples with thickness 0.7mm, 1mm, 1.7mm and 2.5mm were studied and compared. The temperature dependence of the DC resistance, *R*, estimated from the Nyquist plots has been analyzed. At higher temperature, the conductivity versus inverse thermodynamic temperature is exponential and can be explained by a thermally activated transport of Arrhenius type:

$$\ln(R/\mathrm{Ohm}) = \ln k_{\mathrm{resist}} + \frac{E^{\neq}_{\mathrm{resist}}}{R_{\mathrm{gas}} T}$$



Temperature dependence of barium crystal glass (sample thickness 0.7 mm).



Nyquist plot at T = 473 K; *R* = 4.84·10^7 Ohm.

Keywords: electrical impedance spectroscopy, dielectric properties, barium glass

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