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Effect of biopolymer addition on the dielectric properties of modified GO functionalized by added magnetite nanoparticles

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ABSTRACT

In this work, synthesis of Magnetite Graphene Oxide (MGO) by adding magnetite (Fe_3O_4) nanoparticles to Graphene Oxide (GO) is reported via one pot co-precipitation method, followed by addition of chitosan (CS) biopolymer to synthesize MGO/CS blend. Complex impedance spectroscopic studies of the frequency-dependent properties of the prepared materials were subsequently performed, as these provide significant information about the microstructure, which is of great utility in the optimization of design parameters, in particular, for a wide range of applications. Activation energies for both the samples were calculated with the help of impedance studies and a decrease in activation energy of MGO was observed with the addition of chitosan. The ε' values obtained at 300 K were as high as 10^6 at low frequencies in the studied temperature range which gives inference for interfacial polarization with Maxwell Wagner type, and decrease with increasing frequency for all temperatures. Dielectric permittivity variation with temperature at low frequencies (<10 kHz) was observed to be much more pronounced compared to higher frequencies. From the real permittivity data, capacitance and its variation with frequency and temperature were studied for both the samples, and the underlying polarization phenomena were identified. The activation energy calculated from the Arrhenius plots showed that the energy was substantially higher for MGO (~107 meV) than MGO/CS (~67 meV). Further, the value of the height of the potential barrier of MGO (~123 meV) and MGO/CS (~128 meV) samples was estimated, making use of the imaginary permittivity data that reveals a marginal increase in its value due to the addition of the biopolymer.