Dielectric Spectroscopy of Polycarbosilazane-based CuCl$_2$ Metallopolymers

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Abstract

A series of poly (carbosilazane-CuCl$_2$) metallopolymers was prepared by the reaction of varying amounts (5% to 30%) of anhydrous CuCl$_2$ with polycarbosilazane, [-(CH$_3$)$_2$SiNH(CH$_2$)$_2$NH-]$_n$, matrix in tetrahydrofuran under continuous sonication. Dielectric measurements were performed at room temperature (25°C) in the frequency range 1 Hz to $10^6$ Hz. It was found that the ac conductivity increases with increasing the CuCl$_2$ up to 16% and then starts to dramatically decrease. The results reveal that all the dielectric parameters such as ac impedance, dielectric permittivity, and electric modulus behave similar to that observed in ac conductivity. (i.e., maximum or minimum depends on the considered dielectric parameter). It is suggested that at low concentration of metal content, all the CuCl$_2$ is uniformly bound to the backbone of the polymer chains, where the conduction mechanism in the system is by electrons jumping (carrier hopping between the chains), whereas at high metal content the coordination capacity of the backbone is exceeded and CuCl$_2$ is present as molecular clusters that lead to an increase in the interaction distances, and make hopping between chains more difficult, and hence, resulting in a reduction of conductivity.