Dielectric relaxation of dimethylsulfone in water-dimethylsulfoxide solutions

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Dimethyl sulfoxide (DMSO) and dimethyl sulfone (DMSO2) are important and widely used solvents, which have also biomedical significance, especially their aqueous solutions. The dipole moment and the dielectric constant of DMSO2 indicate that it is quite polar, which suggests strong intermolecular interactions in the liquid phase.

Dielectric relaxation studies in microwave region on liquid systems are an efficient tool to investigate the structure and dynamics of molecular interactions. In the present work dielectric relaxation spectroscopy has been used to study dynamic and structural parameters of DMSO2/water, DMSO2/DMSO and DMSO2/DMSO/water systems. The complex permittivity, $\varepsilon^*(\nu)$ measurements, including dielectric dispersion and adsorption spectra of these solutions in large concentration range have been measured by coaxial reflection technique based on a microwave PNA-L network analyzer (Agilent Technologies) from 100 MHz to 50 GHz at four temperatures between 298.15 K and 318.15 K.

The dielectric spectra of these systems can be satisfactorily described by one Cole-Davidson term. The conductivity contribution to the total relaxation must be taken into account only in aqueous solution of DMSO2. The concentration dependent static dielectric constant (ε_S), relaxation time (τ) and relaxation strength ($\Delta\varepsilon$) of these solutions have been determined. The data obtained show that solvent's type is very important in these dependences.

The values of dielectric constant for the DMSO2/water and DMSO2/DMSO/water solutions decrease with increasing concentration of DMSO2 at all temperatures. In case of DMSO2/DMSO solution is observed increase of dielectric constant. The permittivity values of all studied concentrations are found to have a non-linear variation. This non-linear variation of permittivity with concentration indicates the interaction between the components in the mixtures.

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