MICROWAVE DIELECTRIC SPECTROSCOPY OF NEAT IONIC LIQUIDS

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The aim of this work is the study of the dielectric properties of a new class of innovative solvents [1] such as ionic liquids. Because of the ionic structure a strong absorption of microwave radiation is observed in these kind of compounds [2].

In particular 1-butyl-3-methylimidazolium-tetrafluoroborate (BMIMBF4), 1-butyl-3-methylimidazolium-bis-((trifluoromethyl)sulfonyl)amide (BMIMNTF2) and 1-ethyl-3-methylimidazolium-tetrafluoroborate (EMIMBF4) are investigated by means of coaxial reflectance technique in order to obtain real (ε') and imaginary (ε") components of the dielectric permittivity (ε) in the frequency range 500 MHz - 20 GHz. For high conductive compounds like ionic liquids, the imaginary part of dielectric permittivity is largely influenced at low frequencies by the conductive contribution as shown in the following equation:

$$\varepsilon_{dielectric}(\omega) = \varepsilon_\infty + [(\varepsilon_s - \varepsilon_\infty)/(1 + i\omega\tau)] - i\sigma/(\omega\varepsilon_0)$$

where ω is the angular frequency, ε_∞ and ε_s are respectively the high- and zero-frequency limits of the real part of dielectric permittivity, τ is the relaxation time, σ is the static (dc) conductivity and ε_0 is the vacuum dielectric permittivity (8.854×10^{-12} F/m).

Electrochemical impedance spectroscopy (EIS) analysis is performed to calculate the static conductivity values of the ionic liquids under investigation, in order to evaluate the bare dielectric contribution to the loss permittivity. Thus it could be feasible to fit dielectric spectra [3] obtaining parameters that allow to better understand the behaviour of these compounds with microwaves as well as their peculiar physical and chemical properties.

References

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