

Thermodynamic Scaling and Transport Properties of Liquids

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Establishing quantitative relations that relate relaxation and transport properties in the liquid state with molecular interactions is key towards a fundamental understanding of the dynamic properties of liquids. A significant step toward this task is the thermodynamic scaling concept proposed by Roland, Casalini and co-workers [1,2] who concluded that relaxation times, t , and viscosity, η can be expressed as a unique function of Tv^g , where the scaling parameter g reflects the repulsive intermolecular forces, the contribution from internal molecular modes, such as vibrations and torsions, and is also affected by strong intermolecular attractive interactions. This relation was applied to represent the relaxation times and viscosities of a wide variety of liquids [1-3], and could be of great interest in the choice and development of new lubricants for high pressure applications, since it is possible to predict the viscosity at very high pressures using data at moderate pressures over broad ranges of temperature, which are more easily obtained experimentally.

In this work we extend the study to new viscosity measurements of molecular and ionic liquids, and also to other transport properties. Thus, for ionic liquids, the electrical conductivity can be represented using the same scaling exponent obtained from viscosity values. The self-diffusion coefficients of molecular and ionic liquids can also be expressed in terms of a scaling parameter, but the values of g are slightly different from those obtained from viscosities or relaxation times, which means that the transport processes are governed by the same variables, even if the specific dependence is slightly different.

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