

An Application of the Interstice Model to Viscosity of Ionic Liquid BMIBF₄

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Recently, Ionic liquids have received more attention because they have great potential as “green” solvents [1,2]. The viscosity data of ionic liquid is very important for industrial processes so that an application of the interstice model [3] to viscosity of ionic liquid 1-methyl-3-butylimidazolium tetrafluoroborate (BMIBF₄) was found in terms of measurements of the density, ρ , the surface tension, γ , and the viscosity, η in a temperature range from 308.15 to 343.15 K.

According to Yang [3], the interstice model was built on the basis of the following assumptions: 1. since the large size and the asymmetric shape, the ions may not be closely packed and lots of interstices between ions come into existence; 2. in order to calculate the volume easily, the interstice is regarded as a bubble; 3. there are $2N$ interstices for 1 mole 1-1 ionic liquids, where N is Avogadro number; 4. the interstice in BMIBF₄ can move about like an ion or another particle, in the movement the interstice does not vanish, but can be compressed and expanded, which has an extra feature of motion of an interstice called the breathing motion. Therefore, the equation calculated volume of interstice, v , is

$$v = 0.6791(kT/\gamma)^{3/2} \quad (1)$$

where k is Boltzmann constant, T is thermodynamic temperature. And the equation calculated viscosity of ionic liquid is:

$$\eta = 0.68 \rho k T (2\pi M L / \gamma)^{1/2} \exp(E/RT) \quad (2)$$

where M is molar mass of BMIBF₄, L is Avogadro constant, R is gas constant, E is the energy for activation of viscous flow and may be obtained from experimental data of viscosity. The magnitude order of viscosity values, η calculated by equation (2) is in good agreement with that measured by experiment. These results show that the interstice model is reasonable.

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[3] J.-Z. Yang, X.-M. Lu, J.-S. Gui, W.-G. Xu, *Green Chem.* **6**, 541-543 (2004).