Density of 1-Butyl-3-Methylimidazolium Trifluoromethanesulfonate and Methanol Binary Mixtures

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Binary solutions of ILs and various organic compounds are interesting as a thermal storage media or heat transfer fluids (HTFs) in solar heating and absorption refrigerating systems. The thermophysical properties, such as density, heat capacity, vapor pressures, viscosity, corrosivity, thermal stability, speed of sound etc. play an important role during such application. Suitable HTFs for solar energy systems must be thermally stable, chemically resistant, and crystallization should be avoided. For most industrial applications, water is the most popular HTF (high thermal conductivity, high heat capacity, high density, moderate viscosity, and high latent thermal energy). The use of ILs in solar heating and absorption refrigerating systems allows operation below the freezing point of water.

In this work, we present the new density, speed of sound, vapor pressure, viscosity measurements of 1-butyl-3-methylimidazolium trifluoromethanesulfonate and methanol solutions {xCH$_3$OH+(1-x)[BMIM][TFO]} at the temperature range T=(273.15 to 413.15) K. The density $\rho(p_0,T)$/kg·m^{-3} at ambient and saturated pressures measured using an Anton Paar DSA 5000M and DMA HPM vibrating tube densimeters with an uncertainty of $\Delta\rho$ = ± (5·10^{-3} to 3·10^{-1}) kg·m^{-3}. The speed of sound values $u(p_0,T)$/m·s^{-1} at p=0.101 MPa and T = (278.15 to 348.15) K were investigated using the Anton Paar DSA 5000 M vibration tube densimeter and sound velocity meter. Vapor pressure values P/Pa of these solutions were measured using the two high-accuracy static experimental installations: at temperatures T = (274.15 to 323.15) K using a calibrated high accuracy pressure sensor head (Type 615A, MKS Baratron, USA) and at temperatures T = (323.15 to 413.15 K) were using various Omega-Keller pressure transmitters. The dynamic viscosity h/mPa·s of solutions at ambient pressures and in the temperature range T= (273.15 to 413.15) K were measured using an Anton Paar SVM 3000 Stabinger Viscometer with an accuracy in ±0.35 % and Rheometer MCR 302 installations with an accuracy in ±1.0 %.

An empirical equation of state for fitting of the density data of {xCH$_3$OH+(1-x)[BMIM][TFO]} solutions has been developed as a function of temperature and concentration. This equation was used for the calculation of various thermophysical properties of mixtures for example the excess and apparent molar volumes.