Thermophysical properties of 1-hexyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide

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This work was done as part of the IUPAC-sponsored project 2002-005-1-100, "Thermodynamics of ionic liquids, ionic liquid mixtures, and the development of standardized systems". One of the goals for this project was to make reference quality measurements on selected thermophysical properties of a reference ionic liquid. The ionic liquid chosen was 1-hexyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, $[C_6mim][NTf_2]$. A large sample of $[C_6mim][NTf_2]$ was synthesized for the project by Dr. Mark Muldoon at the University of Notre Dame. Analysis with a commercial ion-selective electrode showed that the mass fraction of halide was below the detection limit ($w_{Br} < 10^{-5}$). Before use, the $[C_6mim][NTf_2]$ was dried at room temperature with stirring on a vacuum line using a mechanical pump and a liquid nitrogen trap. Coulometric Karl Fischer titration indicated that the mass fraction of water after drying was less than 10^{-5}. The purity was also checked by ^1H and ^{19}F nuclear magnetic resonance (NMR) spectrometry before and after each set of measurements. In every case, the purity of the $[C_6mim][NTf_2]$ was greater than 99.5 % by NMR. The electrolytic conductivity of $[C_6mim][NTf_2]$ was measured as a function of temperature from (288.15 to 323.15) K using a commercial conductivity cell with platinum black electrodes. Kinematic viscosity was measured at 298.15 K with an Ubbelohde capillary viscometer. Additionally, the viscosity was measured as a function of temperature from (258.15 to 373.15) K with a rotational coaxial cylinder viscometer. The density was measured as a function of temperature from (278.15 to 343.15) K using a commercial vibrating tube densimeter. The speed of sound was measured as a function of temperature from (278.15 to 343.15) K using a commercial pulse-echo device. All of these measurements were performed at atmospheric pressure under anhydrous conditions, and the water content was measured by coulometric Karl Fischer titration after every set of measurements.