Invited Lecture - IL_7 – 1st Sept. 14:00-14:30, Room_C

Graphical Abstract

Thermophysical Properties of Ionic Liquids at High Pressures and Over a Wide Range of Temperature

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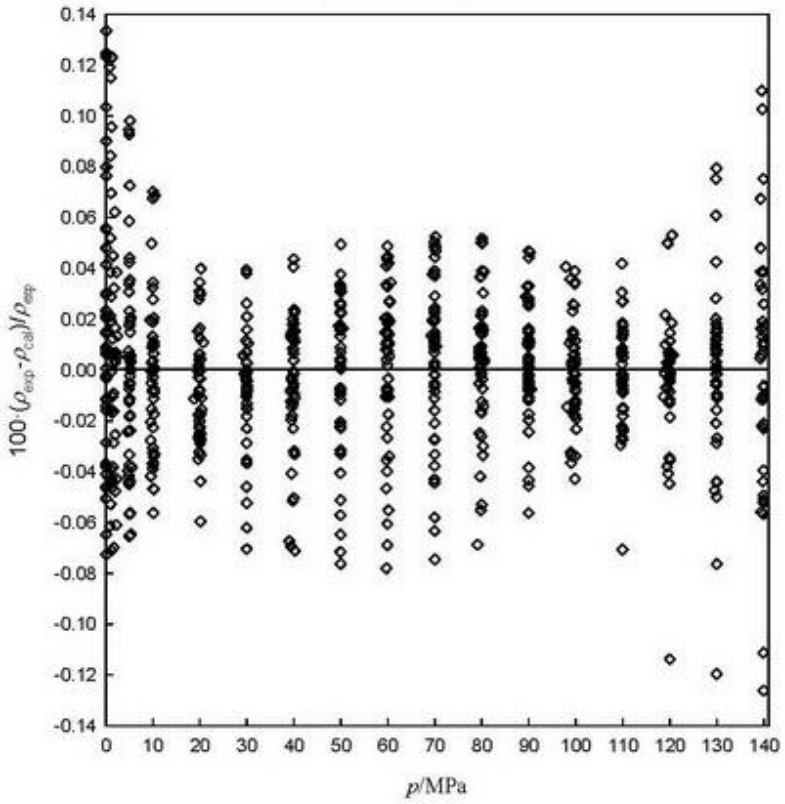

Abstract

Thermophysical Properties of Ionic Liquids at High Pressures and Over a Wide Range of Temperature

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An expanding interest in ionic liquids (ILs) has been observed during the last decade. They have been suggested as potentially "green" replacements for conventional organic solvents since they are nonvolatile (negligible vapor pressure), nonflammable, thermal stable, recyclable and liquid form in room temperatures. They have low melting point, high solvating capacity, high ionic conductivity and high thermal stability. The thermodynamic and reaction kinetics processes in ILs are different from those in conventional media. This creates new opportunities for reaction, separation, photochemical and electrochemical processes. ILs has wide range application as heat transfer fluids and short heat term storage in power plants. In this case, the study of thermophysical properties of them is very important.

In this work, we will present the thermophysical properties of [C_2MIM], [C_4MIM], [C_6MIM] and [C_8MIM] series ILs with various anions at T = (273.15 to 413.15) K and pressures up to p=140 MPa. A homological series of [C_nMIM] ILs, where n= 2, 4, 6, 8 is the even chain length of the alkyl-imidazolium cation has been the most frequently investigated class of aprotic ILs. In contrast, thermodynamic data on the representatives of this family with the odd alkyl chain-length, where n= 3, 5, 7, are practically absent in the literature, probably because the precursors for synthesis of these ILs are hardly commercially available. We have tried to find the community between even and odd alkenes number ILs in the example of 1-$C_n$mim-3-methylimidazolium (n=2, 3, 4, 5, 6, 7, 8) with $[NTf_2]^-$ anion using the molecular weight of ILs. For this purpose, the (p,ρ,T) data of even alcohol number ILs (N=2, 4, 6, 8) with bis(trifluoromethylsulfonyl)imide $[NTf_2]^-$ anions at T = (273.15 to 413.15) K and pressures up to p =140 MPa are reported with an estimated experimental relative combined standard uncertainty of $\Delta\rho/\rho$ = ±(0.01 to 0.08) % in density. The measurements were carried out with a newly constructed Anton-Paar DMA HPM vibration-tube densimeter. The temperature in the measuring cell is controlled using a thermostat (F32 - ME Julabo, Germany) with an error of ±10 mK and is measured using the (ITS-90) Pt100 thermometer (Type 2141) with an experimental error of ±15 mK. Pressure is measured by pressure transmitters P-10 and HP-1 (WIKA Alexander Wiegand GmbH & Co., Germany) with a relative uncertainty of (0.1 and 0.5) % respectively, of the measured value.

An empiric equation of state for fitting of the (p,ρ,T) data of ionic liquids has been developed as a function of pressure, temperature and molecular weight of ionic liquids. This equation is used for the calculation of the thermophysical properties of IL, such as isothermal compressibility, isobaric thermal expansibility, thermal pressure coefficient, internal pressure, isobaric and isochoric heat capacities, speed of sound and isentropic expansion at high pressures and over a wide range of temperature.