167g Electrolytic Conductivities of Hydrophobic Room-Temperature Ionic Liquids

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The electrolytic conductivities of four hydrophobic room-temperature ionic liquids (RTILs) were measured at atmospheric pressure and (288.15 to 323.15) K. The measurements were made with a commercial conductivity cell with platinum black electrodes. In order to exclude atmospheric moisture, the conductivity cell was modified so that it could be sealed during measurements. The RTILs studied were 1-butyl-3-methylimidazolium hexafluorophosphate, 1-hexyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, and 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide. Using a mechanical pump and a liquid nitrogen trap, the RTILs were dried under vacuum with stirring. Coulometric Karl Fischer titration was used to determine the water contents of the ionic liquids before and after each set of conductivity measurements. For most of the electrolytic conductivity measurements the water content of the RTILs was <20 ppm (<0.002 %) by mass. However, some conductivity measurements were purposely performed with up to about 1 % water. The conductivity of the RTILs was found to increase dramatically with increasing water content. For example, the conductivity of 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide increased by about 30 % with the addition of about 1 % water. This work illustrates the importance of measuring the water content of ionic liquids before and after electrolytic conductivity measurements. Lastly, we established the validity of the Walden Rule for an RTIL + water system, since molar conductivity was observed to be inversely proportional to viscosity.