

Water Sorption in Ionic Liquids Characterized using a Dynamic Vapor Sorption Analyzer (IGASorp) and Ambient Pressure X-ray Photoelectron Spectroscopy (APXPS)

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Ionic liquids (ILs) are commonly defined as salts composed of distinct cations and anions with melting points below 100 °C, and many are liquid at ambient temperature. IL research has grown rapidly over the past two decades due to the realization that these materials have many unique properties, such as negligible vapor pressure and outstanding solvation potential. Ionic liquids have been further emphasized by the fact that their physical and chemical properties can be finely tuned by varying both the cation and the anion.

The presence of water in ionic liquids can significantly affect physical properties, as well as chemical properties such as polarity and reactivity. Water is considered the most common impurity in ILs as most ionic liquids are hygroscopic to a certain extent, and preventing their exposure to moisture is quite difficult. Due to the array of conditions used in the numerous IL applications, it is of interest to observe the water uptake of ionic liquids at different temperatures and relative humidities. This study compares bulk and interfacial water uptake in imidazolium-based ILs over a range of temperatures and humidity levels at ambient pressure. Important experimental details on using a gravimetric microbalance (Hiden IGAsorp) for bulk measurements are discussed, and ambient pressure X-ray photoelectron spectroscopy (APXPS) results for water-IL interface are reported. Additionally, this study determines and compares the absorption enthalpies of water in ionic liquids using bulk and interfacial water sorption measurements, as well as reports the diffusion coefficients from bulk data.