

Carbon Dioxide Solubility in Tetrafluoroborate Anion Ionic Liquids at High Pressures and over a Wide Range of Temperatures

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Capture or reduction of greenhouse gases emission to atmosphere is a very actual question at the present time. These activities depend on the processes between the rates of emission of the greenhouse gases into the atmosphere and the rates of processes that will remove or reduction it from the atmosphere. One of the most important greenhouse gases is carbon dioxide (CO₂), beside water. Emission of CO₂ to atmosphere is the main ecological problem, which increase of Earth surface temperature. CO₂ is scattering between the atmosphere and Earth surface, ocean through processes such as atmosphere-ocean gas transfer and chemical and biological processes. There are various technical processes, which are using for the capture of CO₂. One of these ways is solve of CO₂ into the liquids. Ionic liquids (ILs) are regarded as environmentally - benign solvents due to their very low vapor pressure and can be applied for helping with this CO₂ problem. The prediction of CO₂ solubility in ILs is a fundamental step toward the development of simulation tools to aid in the process calculations prior to industrial applications. The experiments to determine the high pressure solubility of CO₂ in tetrafluoroborate IL's at various temperatures at T=(273.15 to 413.15) K are performed in a stainless steel measuring cell in equilibrium by using the isochoric method. Experiments were carried out in four different pressure steps: in the first step, the maximum possible pressure (about 5 MPa) is created in the gas reservoir. The other steps with maximum pressure are: second - about 3 MPa, third – about 1.5 MPa, and finally – about 0.5 MPa. The temperature dependency of Henry's law constant was calculated. Thermodynamic properties of solution such as the free energy of solvation $\Delta_{\text{sol}}G$, enthalpy of solvation $\Delta_{\text{sol}}H$, entropy of solvation $\Delta_{\text{sol}}S$ and heat capacity of solvation $\Delta_{\text{sol}}C_p$ were calculated at various temperatures T to evaluate the solute-solvent molecular interactions. The measured CO₂ solubility in IL as a function of temperature and pressure are fitted to a virial equation using mole fraction dependence.