PURPOSE OF THE ABSTRACT
Since the industrial revolution the harnessing of fossil fuels by combustion for energy and transportation has seen atmospheric levels of CO2 steadily rise. As well as being a greenhouse gas, CO2 can be considered a C1 building block for the production of fuels or chemicals. Electrochemical reduction provides a route to achieve these transformations owing to the potential to reduce CO2 at high efficiencies and selectivity. The main issues to be overcome are the thermodynamic stability of the CO2 and the slow kinetics of the processes, in general. Ionic liquids have been shown to be effective in promoting this electrochemical reduction and in this presentation, the use of reactive super basic ionic liquids are discussed with respect to CO2 capture and utilization. In this presentation a range of ionic liquids consisting of the trihexyltetradecylphosphonium ([P66614]+) cation paired with a superbasic anions have been synthesised and evaluated for CO2 capture and utilisation. The CO2 absorbance in these ILs has been compared under dry and wet conditions as well as in the presence of SO2 and NOx. These effects have been examined using 1H and 13C NMR spectroscopy and ab initio calculations. In general, the CO2 is found to compete effectively with H2O whereas SO2 inhibits the CO2 sorption strongly, for example. Moreover, the ability to repeatedly capture and release the CO2 has been also demonstrated. The enhanced sorption is associated with chemical binding of the CO2 with the anion. These systems were further examined to assess whether this binding could activate the CO2 with respect to electrochemical reduction. Both formate and syngas production have been found to be promoted using the superbase ionic liquids with the former obtained at low applied potentials.