Ionic liquids in the temperature range 150-1500K. Patterns and problems
C.A. Angell
Dept. of Chemistry and Biochemistry, Arizona State University, Tempe, AZ 85287

In this talk we trace some of the history of the subject of ionic liquids from the crimson metal-molten salts of Humphrey Davy’s original melt electrolysis discoveries of elements [1], to the newest ambient-to-200ºC fuel cell electrolytes [2,3]. We discuss the origin of a common pattern of behavior for ionic liquids as they are cooled down, often reaching the glassy state - a pattern that extends from the liquid orthosilicates of the earth’s mantle to the subambient temperature ionic liquids of the present era. However where glasses are rare among orthosilicates and are generally limited to the complex anion “polymerized” silicate liquids (Bockris’ “island anions” [4]) they are the general result when cooling down the ambient ionic liquids of current interest, even though the anions are always simple [5]. How to maintain high fluidity along with low vapor pressure is the challenge, and we discuss the factors involved.

The highest ambient temperature fluidities are obtained with ionic liquids of the proton transfer variety, and they rival aqueous solutions in conductivity [6] - a result of the very high charge concentrations made possible by absence of solvent. These are also the cases that show promise as fuel cell electrolytes. We illustrate the great range of electrolyte character that can be obtained with protic ionic liquids, using an energy level diagram for proton transfers [7]. We compare the fuel cell performance of electrolytes of organic cation protic ILs with that of their inorganic cation cousins.

References:
[1] Sir Humphrey Davy (discoverer of the elements Na, K, Cl I), Researchs, Chemical and Physical” 1800.