Oxidative Chemistry with Ionic Liquids

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Due to their unique chemical and physical properties, ionic liquids have been extensively studied as potential solvents for multiple types of industrial applications.[1,2] Their high thermal, chemical and electrochemical stability enables them to outperform many more conventional solvent systems.[3,4] Additionally, their ability to be prepared with specific solubility properties also enhances their potential use as renewable or regenerable "green" industrial solvents.[5] Our work has investigated the potential use of ionic liquids as not only the solvent system, but also as a source for oxidative or possibly regenerable oxidative capacity. These types of oxidizing ionic liquids could be useful as industrial solvents and to decontaminate chemical and biological agents.

Ionic liquids were prepared using a variety of substituents to "tune" the hydrophobic/hydrophilic nature of the ionic liquid. The ionic liquid was comprised of an imidazolium cation paired with one of two principle anions, bromate and acetate. The acetate anion was then oxidized to generate a peracetate anion. Figure 1 shows the different substituents attached to the 1,2-dimethyl-3-R-imidazolium cation.

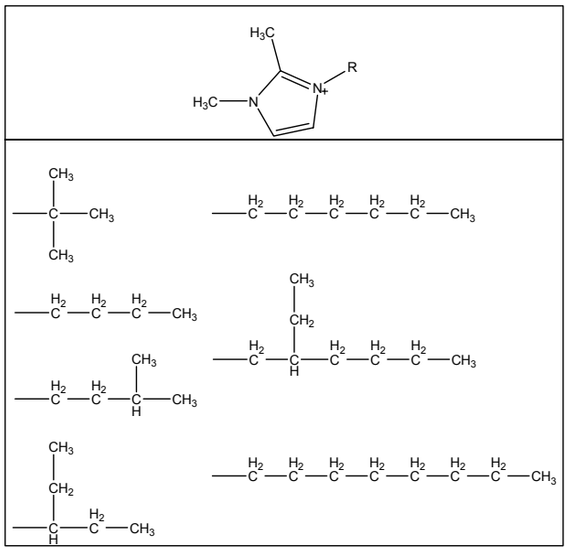

Figure 1. Substituents on the 1,2-dimethyl-3-R-imidazolium cation

Titration methods were used to determine the percent acetate to peracetate conversion for the different ionic liquids. Results indicate that the maximum conversion rate of the acetate to peracetate was between 80 and 90%. The bromate, acetate and peracetate ionic liquids were characterized electrochemically by cyclic voltammetry. Figure 2 illustrates the behavior of the bromate anion using a graphitic working electrode in a typically 3-electrode cell. Thermal analysis shows that for several of the bromates, thermal stability was in excess of 150 ℃. However, degradation of the peracetate typically occurred below 100 ℃.

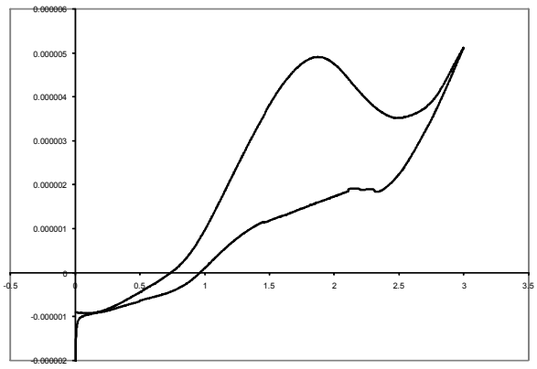

Figure 2. Cyclic voltammogram of the bromated-based ionic liquids using a graphitic working electrode.

References

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