

Investigations of Adiponitrile as a Solvent for Electrochemical Studies

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Introduction

Nonaqueous solvents such as acetonitrile have proven to be extremely useful media in which to carry out a wide variety of electrochemical investigations (1). One disadvantage to the use of acetonitrile is its relatively low boiling point, restricting its use to room temperature applications. This consideration suggests that higher molar mass nitriles would allow higher temperature operations while maintaining good electrochemical properties. Although the physical properties of adiponitrile $[\text{NC}(\text{CH}_2)_4\text{CN}]$ have been presented as favorable to its general use as an electrochemical solvent (2), its use has been mostly confined to work with capacitors (3) and Li-ion batteries (4). The present work explores the use of adiponitrile as an electrochemical solvent for some common redox systems.

Experimental

Adiponitrile was obtained from Aldrich Chemical Co., and tetraethylammonium tetrafluoroborate was purchased from SACHEM. Ferrocene was obtained from Strem Chemicals Inc. Voltammograms were taken with a PAR283 potentiostat using PowerSuite™ software. Potentials are reported with respect to a Ag/AgCl (0.1M EMICl in EMI BF_4) reference electrode (Cypress Systems). All experiments were carried out in a Vacuum Atmospheres drybox.

Results and Discussion

The cyclic voltammogram in Figure 1 shows that adiponitrile has a useful potential range of +2.5V to -2.0V vs Ag/AgCl after drying over 3A sieves. In addition, ferrocene exhibits the usual one-electron reversible behavior observed in nonaqueous solvents. The peak potential separation is rather large (270 mV at 100 mV/s) with 0.12 M TEA BF_4 ; however, this separation is markedly lowered using 0.38 M TEA BF_4 (160 mV). Lowering the scan rate to 25 mV/s further decreases the potential separation. These results indicate that adiponitrile shows promise as a convenient, inexpensive electrochemical solvent for general use over its liquid range of 2°C to 295°C.

References

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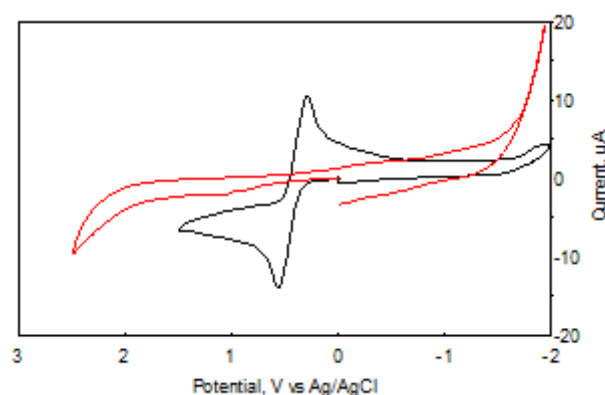


Figure 1. Cyclic voltammogram of 14 mM ferrocene in adiponitrile (0.12 M TEA BF_4) at 1mm diameter glassy carbon, 100 mV/s.