

Electrochemical Studies of Anthracene Derivatives at Nitrogen Tetrahedral Amorphous Carbon Electrodes in Room Temperature Ionic Liquids

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Nitrogen-incorporated tetrahedral amorphous carbon (*ta*-C:N) is one of the key diamond-like carbon types that has recently gained a special attention from the scientific community due to its unique properties such as high mechanical strength, wide usable potential range, and high chemical inertness. However, only a limited number of electrochemical studies have been performed on *ta*-C:N thin-film electrodes. Understanding the electrochemical behavior of *ta*-C:N is therefore important for broadening its application in electroanalytical chemistry. In this study, we report on the characterization and electrochemical properties of *ta*-C:N electrodes. The characterization techniques applied were UV and visible Raman spectroscopy and scanning electron microscopy-energy disperse x-ray spectroscopy (SEM-EDS/EDX). Visible Raman spectra revealed a shift in the G-band position to lower wavenumbers with increasing nitrogen content. The elemental composition and cleanliness of *ta*-C:N films were revealed by energy disperse x-ray spectroscopy (EDX). The electrochemical performance of the *ta*-C:N films were investigated by cyclic voltammetry (CV) using anthracene, 9-phenylanthracene, 9-chloroanthracene, and 9-nitroanthracene redox systems in three different imidazolium-based room temperature ionic liquids (RTILs): 1-ethyl-3-methylimidazolium tetrafluoroborate [EMIM][BF₄] and 1-butyl-3-methylimidazolium tetrafluoroborate [BMIM][BF₄] and 1-hexyl-3-methylimidazolium tetrafluoroborate [HMIM][BF₄]. The electrochemical oxidation of anthracene derivatives occurred at potentials ranging from 1.4 to 2.0 V vs. Ag QRE. All the electrochemical reactions were chemically irreversible and underwent electrochemical reaction following an (EC) reaction mechanism. The electron and mass transfer kinetics for the anthracene derivatives were slower in the viscous RTIL than in conventional organic solvent/electrolyte systems. The results demonstrate that *ta*-C:N electrodes possess electrochemical properties between those of boron-doped diamond and a conventional sp² carbon electrode, glassy carbon.