Electrochemical Characterization of $EMImBF_4$ and Glassy Carbon Interface

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Modern energy storage and conversion devices, as well as the transition to a greener economy, are essential for achieving the goals set by the European Union's energy and climate policies (e.g., the European Green Deal, EU Fit-for-55) [1-2]. One such solution is powerful and sustainable supercapacitors that are based on ionic liquids[3].

The development of supercapacitors mostly relies on studying the processes occurring at the interface between various carbon materials and electrolytes. This is quite a challenge, as carbon material, besides its chemical composition, also has a porous nature. Typically, the electrolyte used is either organic or aqueous, often with an added adsorbable component (organic or inorganic) to improve the supercapacitor's properties[4-6]. From fundamental electrochemical studies, it is known that the adsorption of organic molecules onto the electrode surface occurs due to various interactions[7,8]. By manipulating these interactions through the applied electric field or electrode material, energy can be stored or reactions catalyzed. Therefore, the use of such compounds in the field of supercapacitors holds great potential benefits in terms of both efficiency and sustainability.

The aim of the current work is to study the properties of the interface between an ionic liquid and the carbon electrode. To address the question, glassy carbon electrode is used, allowing for the description of system properties without considering complex porous carbon materials and added organic molecules.

Two research methods are employed: cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). CV is a widely used technique for acquiring qualitative information about electrochemical processes. It enables the electrode potential to be rapidly scanned for redox couples. EIS is a powerful tool for investigating the mechanisms and kinetics of electrochemical reactions, providing information about the interfacial capacitance parameters and reactions (reversible and irreversible adsorption, mass transfer, and faradic charge transfer).

Electrochemical behavior of the glassy carbon and 1-ethyl-3-methylimidazolium tetrafluoroborate ($EMImBF_4$) interface are characterized by CV and EIS measurements. All the experiments are carried out in a three-electrode electrochemical cell in a glovebox, i.e., nitrogen-controlled atmosphere. The studied potential region was 3.6 V and capacitance values are in agreement with previous results[9].

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