Elimination Voltammetry - An Attractive Method for the Evaluation of Electrochemical Processes

Xiaochun Li[*1], Libuse Trnkova[1], Jan Cechal[2], Iveta Triskova[1]
[1]*Department of Chemistry, Faculty of Science, Masaryk University, Kamenice 5, 625 00 Brno*
[2] *Brno University Technology, CEITEC, Purkynova 123, 61200, Brno*
517716@mail.muni.cz

Elimination voltammetry with linear scan (EVLS) is a methodologically new tool for processing voltammetric data in order to obtain more detailed information about the studied electrochemical processes[1]. EVLS processes the records of a linear sweep or cyclic voltammetry into the form of elimination functions, which eliminate some selected current components and preserve others. The impetus for this research was the idea, based on the fact that if the EVLS was applied for a reversible system, then the function preserving only the kinetic current component (E5) or only the capacitive component (E6) with the elimination of the diffusion current component should correspond to the zero current lines[2]. In a common three-electrode arrangement, the current-voltage responses required for EVLS are sensed at the working electrode[3]. In our experiments, the working electrode was represented by a pencil graphite electrode (PeGE) with excellent electrode properties, such as thermal and mechanical stability, low capacitance (charging) current, and high electron transfer rate[4]. It is easily available, cheap, and therefore disposable. Compared to other working electrodes used in voltammetric techniques, it provides more reproducible results. However, graphite pencil leads of different brands can differ from each other and show different electrochemical behavior. We found the best electrochemical activity with the polymer pencil electrode (pPeGE, Tombow) [5]. The validity of our presumptions was investigated by using the reversible probe $[Fe(CN)_6]^{3-/4-}$ on two types of pPeGEs (Tombow from Japan and Staedtler from Germany) which were characterized by X-ray photoelectron spectroscopy (XPS) and electrochemical impedance spectroscopy (EIS). In order to learn more about the composition of their surfaces, the pencil electrodes were exposed to chloroform. Deviations of the experimental EVLS functional records from the theoretical calculation (zero currents for E5 and or E6) are discussed. A number of eliminations were performed under different experimental conditions, and the greatest attention was paid to EVLS E6, which preserves the capacitive current component and sensitively reflects changes in the capacitance of the electric double layer[5]. The study shows that by using the EVLS results, we are able to uncover extra information about voltammetric signals that are hidden by the CV responses.

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