A NEW METHOD OF QUANTITATIVE DESCRIPTION OF SOLID ELECTRODES VOLTAMMOGRAMS

Boguslavskiy V. B., Galimhanova R. V., Maksyutova E. I., Sidelnikov A. V.
Bashkir State University, Ufa
boguslavskiy97@yandex.ru

The phase boundary surface between electrode/solution is under the attention of many researches, working in the electroanalytical chemistry. This surface serves as a specific microreactor in which many temporal and electrochemical processes being under the controlled conditions give useful information about the electrode material, structure of the surface, about the components of the solution reacting in the depth of the solute and near the DEL.

New materials and innovation technologies related to formation of the structural surfaces with the usage of different composites, supramolecular structures etc. require more informative and sophisticated methods for the various electrodes-sensors creation and taking into account other factors that can modify the given electrode in the stage of its production or in the process of its reaction with components of solution under investigation. From one side, a researcher has a variety of different sensitive equipment however, from another side for the mathematical treatment of the data obtained and construction of the informative and effective models, new approaches are necessary. The most vital problem in this attention is related to description and quantitative characterization of the electrode surface in its continuous interaction with solution components. This problem is tightly related to creation of new generation of multisensor systems, which enable to detect all temporal changing in the process of its interaction with the solute under investigation.

When the number of the measurements are rather small there are mathematical methods that take into account the drift of the detected signal in time while for the multi-cycling sensor(the number of the measurement cycles are large, $M \geq 1000$) the mathematical methods related to quantitative monitoring of these sensors in time are not well developed. In this case, the electrode surface is changed significantly and can reflect the different stages of its electrochemical transformations.

The saying above put forward a problem related to new and general mathematical method creation that can control quantitatively the evolution state of the electrode surface and expresses it in terms of the finite number of the given parameters. This method based on the usage of the discrete geometrical invariants (DGI) developed in this paper.

In this paper, we apply the statistics of the fractional moments (SFM) and discrete geometrical sets/invariants (DGI) for explain of the temporal evolution of the electrochemical background. For analysis of this phenomenon, we apply the internal correlation factor (ICF) and proved that integral curves expressed in the form of voltammograms (VAGs) are more sensitive in comparison with their derivatives. For analysis of the VAGs (integral curves), we propose the set of the quantitative parameters that form the invariant DGI curves of the second and the fourth orders, correspondingly. The method of their calculation based on the generalization of the well-known Pythagor's theorem is described. The quantitative parameters that determine these DGI allow monitoring the background of the electrochemical solution covering the period of 1-1000 measurements for two types of electrode (Pt and C) and notice the specific peculiarities that characterize each electrode material.

This work was supported by the Russian Foundation for Basic Research, project № 17-43-020232 r-Povolzh'ye-a.