ABSTRACT

In the frame of doctoral dissertation we conducted studies and investigations of new approaches for development of bismuth films electrodes, which are nearly two decades suitable alernatives for mecury-based analogues, and their introduction into the filed of modern electroanalytical detection also of less common organic analytes.

In the first part we were focussed on the preparation and characterization of nanostructured bismuth film electrode (nsBiFE) for trace analysis of heavy metal ions, i.e. cadmium and lead. In this study, we presented that with the use of multi-pulse galvanostatic voltammetry we can create nanostructured bismuth film that exhibits superior electroanalytical performance in comparison to ex-situ, as well as to in-situ counterparts. In the subsequent work, for the purpose of a routine analysis of lead ions, we developed user-friendly sensor, based on bismuth imidazolate (BiIm). Uniqueness of the proposed sensor is not only in its easy and rapid preparation, but it can also be reuse several times without any loss in its electroanalytical activity.

For the introduction into electrochemical detection of organic compounds, the research was dedicated on the development of bismuth-based screen-printed electrode for voltammetric monitoring of nitroaromatic explosives and their vapors. For this purpose, we created bismuth oxide (Bi_2O_3)-based ink that, coupled with the screen-printed techniques, is suitable for production of potential wearable sensors. With the investigation of its analytical application we demonstrated that Bi_2O_3-screen printed electrodes (BiSPEs) under conditions of adsorptive cathodic stripping voltammetry (AdCSV) exhibited favourable electroanalytical behaviour for dinitrotoluene (DNT) detection that is comparable to its carbon counterparts. When covered with hydrogel that type of bismuth sensor can be suitable for detection of nitroaromatic vapors.

The last part of dissertation work involves a study of potential application of bismuth based electrode as a diagnostic tool for assessing the levels of progesterone in the mid- and late-term pregnancy. According to preliminary results, the nanostructured bismuth film electrode (nsBiFE) enabled linear voltammetric response of progesterone in the examined concentration range of 0,1 to 0,7 μM. To point out, all related measurements in this research were conducted in neutral media (physiological pH values), which is promising from the point of view of potential utiliuzation as an »on-site« electrochemical sensor.

Key words: stripping voltammetry, nanostructured bismuth film electrode, bismuth imidazolate, bismuth screen-printed electrode, Pb^{2+}, Cd^{2+}, nitroaromatic explosives, hormones