

Abstract

This work deals with the development of ITIES-based (ITIES – the interface between two immiscible electrolyte solutions) miniaturized sensors for the analysis of psychoactive substances. In first, the fiberglass membranes or fiberglass membranes modified with a thin film made of polyelectrolytes was used as the ITIES support. The proposed method allowed for the size screening of different model ions (family of quaternary amines) depending on the charge of the polyelectrolyte terminating formed multilayer. Next, a microplatform based on an array of microholes fabricated in a self-adhesive polyimide tape was created using a probe equipped with a set of microneedles. Developed platform was applied for ephedrine detection. Electrochemical experiments focused on studying the interfering substances (cutting agents) that can be potentially find in drug street samples defined the third objective of the concerned thesis. Macroscopic ITIES was used to determine a number of physicochemical and analytical parameters related to a broad range of cutting agents undergoing ion transfer across the ITIES. The third developed method of miniaturization is based on porous aluminum thin foil. The foil was oxidized in a laboratory stove to increase the stability of the ITIES formed within its pores (the effect of increased hydrophilicity upon oxide formation). The developed microplatform was used to detect norcocaine, a pharmacologically active and highly toxic metabolite of cocaine. Tests were performed on model and spiked urine samples. As a part of this doctoral dissertation, a sensor allowing the heroin detection in a droplet (volume of the aqueous phase: 10 - 20 μL ; volume of the organic phase approx. 5 μL) was proposed. The final sensor design was printed with 3D technology, and further connected to a microtip prepared using fused silica microcapillary. In conclusions, it can be stated that a cheap, simple and easy to construct platforms with the use of commonly available materials can provide fully functional tools for the drugs analysis. From the analytical point of view, electroanalytical procedures have been developed allowing the detection of the chosen analytes in a reproducible and selective manner.