eQualitySens

eQualitySens - Electrochemical Sensing platforms spatial fabrication brings eQuality to Quality control. Case study - illicit drugs.

Project goal: We aspire to develop, understand, and analytically define a number of novel sensing solutions based on 3D fabrication and liquid-liquid interfaces. This project is about looking for new fabrication approaches that can provide supports for the systems based on the three-phase junctions (liquid-liquid-solid interface), and liquid-liquid interface to detect new and emerging psychotropic substances (illicit drugs).

Description of research: The **eQualitySens** project is built with a few interconnected experimental steps which are about the development of fabrication methodology, excessive experimental characterization, and detailed analytical study of a range of illicit drugs. Principal investigator, postdoctoral fellow, PhD student, and MSc students (project group) will be involved in the following aspects:

(i) The most challenging aspect will be the development of an electrochemically assisted 3D printing/writing strategy. At this point, carefully selected reactions happening at the electrode surface will be used to drive the deposition of materials over the support placed below the electrode. The electrode will be moved along x-y-z axis with the simultaneous deposition process. At this point, we will form gelled phases electrochemically printed over conducive supports that will be working as sensors.

(ii) The second aspect that will be developed is about using digital light processing and/or stereolithographic 3D printing for making supports for the electrified liquid-liquid interface.

(iii) The third methodology that will be developed during this project execution is related to pyrolytic laser engraving of the 3D printed objects leading to the formation of conductive supports. These will serve as the electrodes alone or will be further modified leading to three-phase junctions.

All three approaches will be optimized, characterized, and applied for illicit drug detection during the entire project duration. The list of illicit drugs considered as the target analytes is made based on the principal investigator's experience and information provided by the toxicological laboratory. In this project, we will create the electrochemical map of the studied compounds that can be used to develop selective sensing solutions allowing for the presumptive verification of illicit drugs street samples composition.

Reasons for attempting a particular research topic: The **eQualitySens** addresses several scientific problems. The first challenge is to find solutions that can turn soft sensing interfaces into a fully functional platform. In this respect, we will fundamentally developed cheap fabrication protocols that will stabilize soft junctions for a prolonged time. The second major aspect driving our electroanalytical curiosity is about **illicit drug sensing.** Electrochemical solutions aspire to become a leading technology in the presumptive detection of illicit drugs. To realize this aspiration we first need to tackle scientific challenges: (i) The everchanging composition of illicit drugs street samples requires massive profiling and the analysis of a significant amount of data in the form of electroanalytical fingerprinting of the street samples as a matrix and all their components individually. (ii) New emerging drugs are flooding the black market, and hence, these molecules should be added to the database. (iii) We need to define the limitations of the electroanalytical solutions. (iv) Whenever selective detection of a drug is not possible with a single approach, we need to merge different electroanalytical tools.

Substantial results expected: We will generate a solid portion of fundamental knowledge. Only the solutions that are understood can be translated into fully operational aspects. In this respect, we will define the novel sensing interface fabrication methodologies exhibiting superior performance. Also, we hope to deliver a substantial portion of information about the electrochemical behavior of new and emerging illicit drugs along with their cutting agents. This knowledge will be used for reliable yet still presumptive sensors development. Created knowledge will be published in the top international scientific journal.