Grand public summary

In this project, the electrochemistry (domain studying the border between the electricity and chemical reactions) will be used as a tool to detect common illicit drugs (e.g. cocaine, heroin, amphetamine, tetrahydrocannabinol – active component of marihuana). These molecules were recognized as causes of many societal problems. Illicit drugs production, trafficking and distribution are very much related to the crime rate. Their consumption has a destructive effect on addicts health, including direct (e.g. Hallucinations, stroke) and indirect (e.g. HIV, Hepatitis C infections) consequences. It is obvious that reliable, cheap and accessible illicit drugs detection solutions are in high demand.

Current solutions used for illicit drugs sensing include two main streams. The first group belongs to colourimetric tests, that upon reaction with a drug molecule give a colour change. These are primitive tools that suffer from lack of selectivity (other substances known as false positives may also lead to a colour change) and problems with result interpretation (colour interpretation may diverge from user to user). Undoubtedly, low price is their highest advantage. On the other hand, we have sophisticated facilities used in forensic institutes and analytical laboratories like e.g. mass spectrometry or chromatography. These techniques are currently irreplaceable even though they require dedicated space, trained personnel, frequent maintenance and constitute a financial barrier, especially in developing countries. Electrochemistry based solutions proposed in this project aspire to fill the gap between primitive colourimetric tests and sophisticated facilities used by certified laboratories. We plan to develop cheap, reliable, but still, presumptive detection solutions that that can be used for rapid illicit drugs detection.

Before reaching this ultimate goal, a number of fundamental scientific questions have to be answered. We believe that the superior properties of these analytical platforms can only be reached when these are entirely understood. To be more specific, we will work on the following aspects:

(i) We will develop a new type of polymeric membranes decorated with micrometre features. With these membranes, it will be possible to miniaturize sensing devices, reduce the number of used chemicals and materials (also reduce the volume of sample needed for analysis) and improve the performance of the sensing platform.

(ii) We will use a truly unique system based on water – oil interface and combine it with electrochemical sensing. The transfer of illicit drugs from one phase (say water) to another (say oil) can be recorded as the electric current (which in turn is one of the analytical signals of the sensing platform).

(iii) We will study how miniaturization affects detection of illicit drugs at solid electrodes (e.g. made out of carbon). The surface of these electrodes will be additionally decorated with chemicals having the ability to recognise the presence of specific illicit drugs.

(iv) We will summarize all scientific outcomes. The platforms exhibiting the best performance will be used to detect illicit drugs from real samples (e.g. street samples collected by forensic authorities from the crime scene). Their performance and utility will be evaluated.

This work aims to give new tools to fight against a real societal problem – illicit drugs of abuse. In the future, the solutions developed in this project could be part of a sensing device with a size similar to a typical smartphone. By giving the answer to a number of fundamental questions, we hope to trigger this exciting development.