

Electrochemical sensing. Targeting illicit drugs.

Mater project proposal

Duration: 6 months

Introduction

Need for sensing in general roadside testing, wellness, clinical diagnostics and finally presumptive drug testing stimulate fundamental and applied research in order to develop new solutions that allow gathering information.

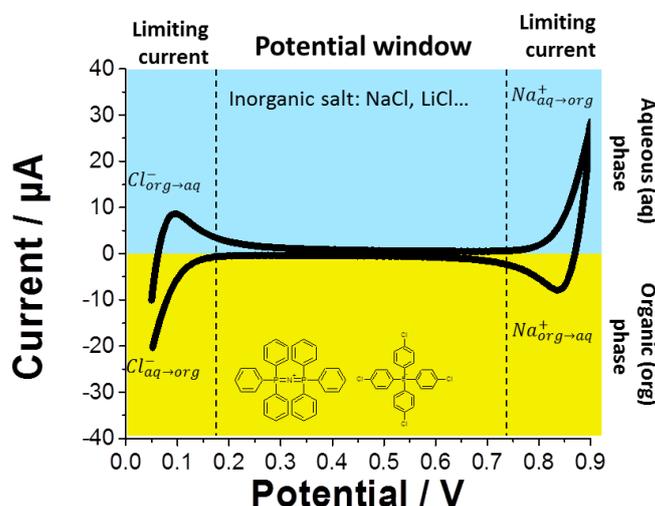


Figure 1. Cyclic voltammogram for the ities composed from 10 mM NaCl and 10 mM bis(triphenylphosphoranylidene) ammonium tetrakis(4-chlorophenyl)borate (BTPPA⁺TPBCl⁻). Currents recorded within the available potential scale are only due to interfacial ion transfer reaction.

Electrochemistry at the liquid – liquid interface (also known as the interface between two immiscible electrolyte solutions - **ities**) is a truly unique and bioinspired approach. Among many applications, ities was recognized as a sensing platform with detection that can arise from simple interfacial ion transfer reaction. This feature distinguishes **ities** from solid electrodes where the signal is usually attributed to electron transfer reaction. Fundamental aspects of the **ities** can be found in Figure 1.

One of the challenges of modern society is to inhibit or eliminate **increasing abuse of illegal drugs**. Such activities are within the tasks of the authorities like customs service, police or forensic officers. In order to facilitate their work fast, reliable and specific detection schemes have to be realized. Most commonly used approaches rely on methods like gas chromatography combined with mass spectroscopy (GC-MS), liquid chromatography (LC), Infra-red (IR) or Raman spectroscopy . Although highly specific and sensitive all these techniques are very expensive (due to costly instrumentation) whereas the results of analysis are difficult to interpret (requires experienced user). These drawbacks

can be circumvented with the electrochemical techniques that offer (i) user-friendly data analysis, (ii) fast and reliable response, (iii) low cost and (iv) miniaturization possibilities.

In this project, the student will be involved in the electrochemical characterisation of a number of illegal drugs. Selectivity, sensitivity, limits of detection among other electroanalytical parameters will be evaluated.

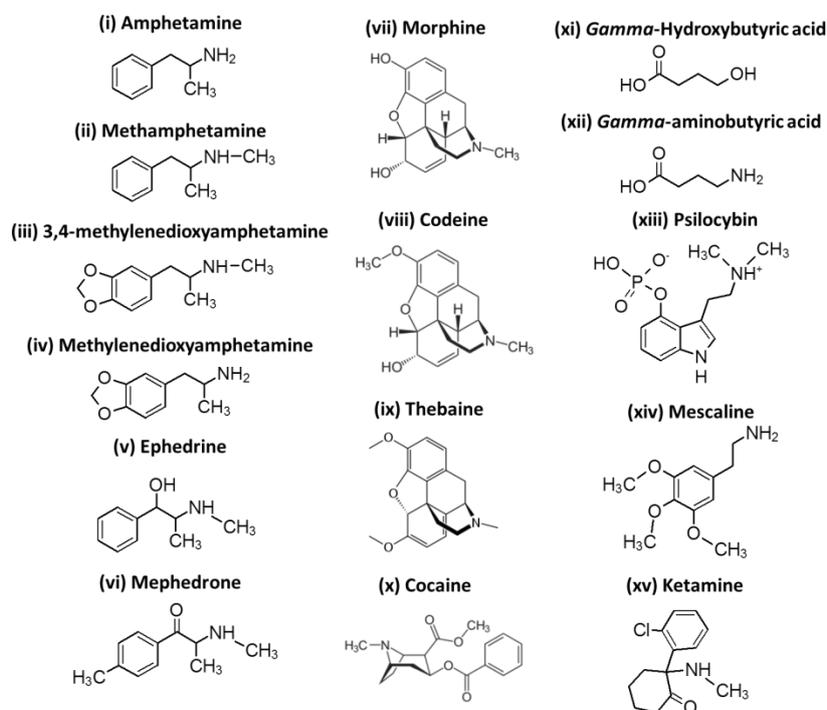


Figure 2. *Illegal target drugs of the electrochemical sensor based on the liquid – liquid interface.*

During internship student will learn:

- Basic electroanalytical techniques;
- Miniaturization;
- Surface and interface modification and characterisation.

Basic concepts:

- Electrochemistry at the liquid – liquid interface;
- Ion transfer voltammetry;
- Silanisation;
- Sensing;
- Illicit drugs – Figure 2 (amphetamine, methamphetamine, cocaine, GABA, GHB...).

Literature:

- [1] Z. Samec, Electrochemistry at the interface between two immiscible electrolyte solutions (IUPAC technical report), *Pure Appl. Chem.* 76 (2004) 2147–2180.
- [2] L. Poltorak, K. Morakchi, G. Herzog, A. Walcarius, Electrochemical characterization of liquid-liquid micro-interfaces modified with mesoporous silica, *Electrochim. Acta.* 179 (2015) 9–15. doi:10.1016/j.electacta.2015.01.129.