**Wearable electrochemical multi-electrode platform for ion-sensing in sweat**

**Contacts:** Dr MER Sandro Carrara, Senior Scientist, EPFL-IC-IINFCOM-LSI  
Francesca Criscuolo, PhD student, EPFL-IC-IINFCOM-LSI

Ion-sensors are widely used chemical detection systems with applicability in many different fields (Figure 1). So far the most efficient and precise ion-sensing devices employ electrochemical measurements based on Ion-Selective Electrodes (ISEs). Medical analysis constitutes the largest area of routine application of ISEs thanks to the availability of accurate Ion-Selective Membranes (ISMs) for several clinically relevant ions (Cl⁻, Na⁺, K⁺, Ca²⁺, H⁺), large demand and low production costs. Conventional ISEs are very accurate, with small potential drift and long lifetime. However, the internal electrolyte of ISEs is prone to evaporation and highly sensitive to temperature and pressure variations that can lead to large volume changes and eventually to delamination. Moreover, and most importantly, the filling solution inside the electrodes. This drawback prevents their miniaturization and applicability for Lab-On-a-Chip (LOC) devices. Therefore, over the past 50 years several all solid-state potentiometric ions-sensors have been implemented towards next-generation portable and miniaturized ion-sensing devices integrated with steering circuits and read-out electronics.

![Fields of application of ion-sensors.](image)

Flexible platform integrated in a smart headband for ion-sensing in sweat. The measured potential is proportional to the target ion concentration.

**Project tasks:**
- **Microfabrication of a multi-sensing platform on a flexible substrate** for in-situ sweat sensing. Both cleanroom processes and printing techniques will be investigated.
- **Realization and optimization of a temperature sensor and a miniaturized stable reference electrode.** The miniaturization of reference electrodes constitutes one of the main challenges of the field to ensure accurate potentiometric measurements and limited potential drift.

- **Integration with the nanostructured ion-selective sensors** that are being developed in the lab.

- **Morphological, mechanical and electrochemical characterization** of the platform.

- Integration of paper microfluidics (according to the available time)

**Eligibility Requirements:**

- Basic knowledge of lithography and microfabrication

- Basic knowledge in electrochemistry

- Interest and motivation

**Reference**

2. A. Lewenstam, Routines and challenges in clinical application of electrochemical ion-sensors, Electroanal. 26 (2014) 1171–1181