INSTITUT DES SCIENCES ANALYTIQUES

Proposition sujet de thèse

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Titre: Nouveaux patchs potentiométriques portables pour la surveillance continue de la santé
Title: Novel potentiometric wearable sweat-sensing patches for continuous health tracking
Keywords: potentiometric, chitosan, ionophore, sweat, wearable devices, Android App

Context and objectives:

The ideal healthcare system would enable continuous health monitoring and early intervention, detecting suboptimal health conditions before the onset of disease. In contrast, the current approach relies on patients seeking medical attention only after noticeable symptoms develop, leading to reactive treatment and passive monitoring by specialists. There is an urgent need for self-monitoring solutions that allow individuals to detect health issues early and manage them effectively without relying on expensive equipment or trained professionals. This demand has driven ongoing research into advanced materials and innovative sensor designs for chemical sensing systems that accurately detect physiological signals and disease biomarkers while maintaining biocompatibility. Among emerging technologies, wearable patch-based sensors have shown great potential for effective sweat analysis, offering easy induction, reliable collection, and precise biomarker detection (Fig.1). Sweat analysis has gained attention due to its unique advantages: high accessibility, non-invasiveness, and ease of use, compared to traditional blood and urine analyses [1,2].

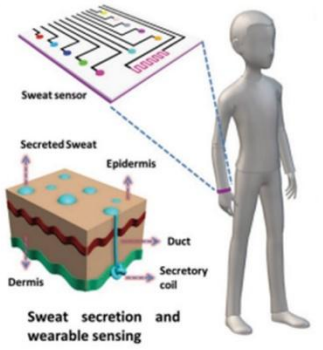

Fig 1. Wearable sweat sensors for detection of sweat markers.

Sweat contains a rich array of biomarkers, including electrolytes (e.g., sodium, potassium, chloride, ammonium, calcium), metabolites (e.g., glucose, lactate, alcohol), trace elements (e.g., iron, zinc, copper), small molecules (e.g., cortisol, urea, tyrosine), neuropeptides, and cytokines [3-5]. Given this wealth of physiological information, wearable sweat sensors hold great promise for fitness tracking, health monitoring in high-performance sports, and medical applications such as disease diagnosis and continuous patient monitoring [6,7]

The aim of this thesis is to develop a novel flexible potentiometric wearable sweat-sensing patch based on the biocompatible polymer polylactide (PLA) for the continuous monitoring of the following ion concentrations in sweat: pH, Na^+, Ca^{2+}, and NH_4^+.

This thesis will be carried out through the following tasks:
1/. Development of flexible transducers based on PLA, integrating an array of gold working microelectrodes and silver/silver chloride reference microelectrodes using microcontact printing combined with a wet etching process.
2/. Implementation of cyclic voltammetry for the selective electro-addressing of chitosan doped with different ionophores to detect the corresponding ions.
3/. Characterization of the developed wearable sweat-sensing patch (W2SP) using contact angle measurements, FT-IR, XPS, and AFM techniques.
4/. Electrochemical characterization of the W2SP for the detection of the four ions in artificial sweat using potentiometric measurements, evaluating sensitivity, selectivity, lifetime, and drift.
5/. Validation of the developed W2SP using real sweat samples.

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