Concours de l'Ecole Doctorale de Chimie de Lyon - 2023

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Titre : Développement d'une plateforme électroanalytique connectée au smartphone pour la détection du cancer du sein à partir d'échantillons de salive

Title: Development of an electroanalytical platform connected to the smartphone for the detection of breast cancer from saliva samples

Keywords: Copper-free click chemistry, Soft-lithography, Breast biomarker, Saliva, Electrochemical impedance spectroscopy, Android App

Context and objectives:

Breast cancer (BC) is the most common cancer and the primary cause of cancer death for women around the world. About 531 086 new cases were diagnosed in Europe in 2020, among which 58 083 new cases were in France, causing a total number of deaths of 14 183 [1, 2]. Efficient screening and early breast cancer detection programs using mammography are commonplace in developed countries. Furthermore, biomarker analyses in serum (liquid biopsies) are emerging, and genomic biomarker analyses are beginning to be implemented for cancer diagnostics. In LMICs, however, a cancer diagnosis often occurs after advanced symptoms, for example, palpable mass lesions, weight loss, and malaise. It is not uncommon for biopsy diagnosis to take several months, given the lack of surgeons, interventionalists, and pathologists, bottlenecks in specimen acquisition, complex handling logistics, and other factors [3]. However, these methods are often laborious, time consuming.

The aim of the present thesis project is to address the above problems of delayed diagnoses, by **development of automated, rapid, portable, and affordable diagnostic and profiling technologies for early screening of breast cancer.** The **non-invasive** system is based on a **novel point-of-use platform** for breast cancer biomarkers analyses in saliva (HER1, HER2, CA 15-3 and CA 27.29). Saliva presents several biochemical advantages over blood. For a start, its collection is safer than blood (no needle punctures), making it both noninvasive and relatively simple to collect with the capacity for repeated collection without a patient's discomfort. In addition, salivary biomarkers have been found to be a filtrated fraction of the blood, making them a reflection of the physiological condition of the body. **The platform is based on functionalized gold microelectrodes with the corresponding antibodies connected with commercial potentiostat directly inserted in a smartphone** and controlled via the Android app PStouch. **A novel strategy of antibodies immobilization, using photocrosslinking followed by cooper-free click chemistry** will be used**.** The electrochemical Impedance Spectroscopy technique will be used to study the analysis of saliva samples.

This thesis project will be conducted following the following tasks:

1. Development of **novel strategy** for the labeling to the heavy chain of antibodies **with two dibenzocyclooctyne (DBCO) labels by photocrosslinking process**.
2. **Immobilization of labeled antibodies** on functionalized gold microelectrodes **using the novel copper-free click chemistry.**
3. Characterization of the functionalized surface via contact angle, FT-IR, XPS, and AFM techniques.
4. Electrochemical characterization of the developed platform using artificial saliva and real saliva.
5. Validation of obtained results against those obtained by ELISA.

References:

[1]. https://gco.iarc.fr/today/data/factsheets/populations/250-france-fact-sheets.pdf.
[2] H. Ziyu, C. Zhu, T. Miduo, E. Sauli, L. Yuan, L. Taotao, D. Yan, H. Nongyue, L. Song, F. Juan, L. Wen, A review on methods for diagnosis of breast cancer cells and tissues, Cell Proliferation. 53(2020)12822.
[3] IL. Mendes, MFD. Neves, FS. Lopes, Biosensor applicability in breast cancer diagnosis. Int J Biosen Bioelectron. 5(2019).

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