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Development of electroanalytical platform combined with potentiostat directly inserted in a smartphone for the detection of breast cancer biomarkers in saliva samples.

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

Context and objectives:

The global cancer burden has risen to 18.1 million new cases in 2018 and is projected to reach 29.5 million new cases by 2040 [1,2]. In 2018, there were 9.6 million cancer deaths, making cancer the cause of death for 1 in 8 men and 1 in 11 women. More than two-thirds of cancer deaths occur in low- and middle-income countries (LMICs). Efficient screening and early breast cancer detection programs using mammography are commonplace in developed countries. Furthermore, serum biomarker determination (i.e. by liquid biopsies) is rising importance in are emerging, and genomic biomarker analyses are beginning to be implemented for cancer diagnostics. However, in LMICs, cancer diagnosis often occurs after advanced symptoms, such as palpable mass lesions, weight loss, and malaise. It is not uncommon for diagnoses by biopsy to take several months, given the lack of surgeons, interventionalists and pathologists, bottlenecks in specimen acquisition, complex handling logistics, and other factors [3], also because these methods are often laborious and time consuming.

The aim of the present thesis is addressing the above mentioned problems of delays in breast cancer diagnoses, by developing automated, rapid, portable, and affordable diagnostic and profiling technologies for early screening of breast cancer. Saliva analysis presents several advantages if compared to blood. Its collection is safer than blood (no needle punctures), making it both noninvasive and relatively simple to collect resulting more suitable especially for repeated sampling and reducing patient's discomfort. In addition, salivary biomarkers can reflect the physiological condition of the body. The non-invasive system is based on a novel point-of-use platform for saliva biomarkers (e.g. HER1, HER2, CA 15-3 and CA 27.29)determination based on microelectrodes functionalized with the corresponding antibodies and connected with commercial potentiostat directly inserted in a smartphone, which will be manageable by the Android app *PStouch*. The electrochemical Impedance spectroscopy technique will be used for the analysis of saliva samples.

This thesis will provide following the tasks:

1- Fabrication of the transducers using soft-lithography;
2- Immobilization of antibody using the novel copper-free click chemistry;
3- Characterization of the functionalized surface via contact angle, FT-IR, and AFM techniques;
4- Electrochemical characterization of the developed platform using artificial saliva and real saliva from patients;
5- Validation of obtained results by comparison with a reference method (ELISA).

References:

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[3]. A. M. Nelson et al., Oncologic care and pathology resources in Africa: Survey and recommendations. J. Clin. Oncol. 34, 20–26 (2016).

Contact:

Candidates should send CV, cover letter and contact the supervisors: Prof. Abdelhamid Errachid (abdelhamid.errachid@univ-lyon1.fr) or Dr. Nadia Zine (nadia.zine@univ-lyon1.fr)

Institut des Sciences Analytiques - UMR 5280
5 rue de la Doua - 69100 Villeurbanne - France
www.isa-lyon.fr

UNIVERSITÉ DE LYON cnrs UCBL Lyon 1