

Key words : *Analytical chemistry, Bio-functionalization, Bio-Electronic Nose*

PhD Research proposal 2018

Development of Bio-Electronic Nose for breath analysis: Application in breast cancer

Proposed topic:

For women, breast cancer (BC) remains the most commonly diagnosed malignancy and accounts as the second leading cause of the cancer-related deaths. Early diagnosis is one of the most important strategies to reduce BC morbidity rate and to improve the survival rate. The conventional BC diagnostic techniques include mammography, ultrasound imaging, magnetic resonance imaging (MRI), CT scan, positron emission tomography (PET) scan and biopsies. However, this conventional BC diagnostics techniques are always expensive, discomfort, and even harmful to patients with less optimal accuracy. Therefore, there is an urgent clinical need to improve or alternate these methods through developing new economic, comfortable, effective and non-invasive methods to safely and accurately diagnose BC in its early stages.

The developments in diagnostic methods and monitoring technologies have focused on blood and urine analysis for cancer diagnostics by detection of molecular biomarker. Molecular biomarkers generally can provide prognostic symbols and their diagnostic detection is becoming increasingly important in early diagnosis of various diseases including cancers. However, blood and urine matrixes are far more complex than breath sample, which makes molecular biomarkers searching and detection extremely difficult. In addition, the sample collection procedures for blood and urine are either invasive or inconvenient. Nevertheless, the relatively fast equilibrium in the lungs between substances dissolved in blood and the alveolar gases provides the opportunity to detect these substances in the gas phase, rather than in the liquid phase. Furthermore, breath analysis is non-invasive, painless, easy to perform and no risk to patients, thus, it can be used in clinical application including cancer identification.

The aim of this thesis is to develop a new generation of Bio-Electronic Nose based on the combination of semiconductor-based sensor and biomaterials for detection of formaldehyde exhaled from breast cancer patients.

The candidate will contribute to the main tasks:

- The first task is devoted to the fabrication of interdigitated microelectrodes on flexible substrate combining microcontact printing and wet etching process.
- In a second task, the work will be focused on growing electrochemistry conducting polymer doped with enzyme.
- In a third task, we will characterize the developed Bio-electronic nose at the level of the laboratory to study the sensitivity, selectivity, stability etc...
- Finally, the developed Bio-electronic nose device will be used for the characterization of artificial exhaled breast.

Requirements for a candidate: A good background in analytical chemistry and Biochemistry.

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