Ph.D. Thesis proposal

General Information		
Ph.D. Thesis Title	***Development of Electrochemical microfluidics techniques for prostate cancer markers detection in biological fluids.***	
USEK Doctoral Program	***PhD in chemistry***	
Research Center	NA	
Research Group	NA	
Research Axis	***Axis: Multiphases Bio-Chemical Analysis & Equilibrum Between Phases*** ***Theme: Development and validation of analytical procedures-(Microfluidic system and Bio-electrochemical analysis)***	
PhD Supervisor	Name & Title : Joseph Saab, Professor Email : josephsaab@usek.edu.lb	University Address : Holy Spirit University of Kaslik-USEK
Co-supervisor (if applicable)	Name & Title :Abdelhamid Errachid, Professor Email :abdelhamid.errachid-el-salhi@univ-lyon1.fr	University Address : Claude Bernard University Lyon 1-UCB Lyon 1
Location (s)	Location 1: USEK	Work shift calendar /per year (%): 40-50
	Location 2: Claude Bernard University Lyon 1- UCB Lyon 1	Work shift calendar /per year (%): 50-60

Applicant Profile and/or Special Requirements	Applicant Profile: Master's degree in Chemistry or Biochemistry Special requirements: practical experience in electrochemical analysis, Microfluidic Systems.		
Comps Exam Language	☐ Arabic	☐ French	×English

Context of the Topic & Scientific Methods ***(Research impact, objectives, design, methods, and outputs)***
The main objective of this project is to develop a miniaturized platform based on flexible substrates for the separation, analysis and detection of prostate cancer biomarkers in biological fluids. This approach requires the development of new electrochemical functionalities. As part of this program (Short-term objective), we will evaluate theoretically and experimentally the capabilities of an approach combining microfluidics and electrochemical analysis techniques (potentiometry, impedancemetry) for selective detection of prostate cancer biomarkers, contained in the biological fluids. In fact, we will develop steps or tools that allow (1) the elimination of interfering species from solutions during the markers detection and allow (2) the independent quantification based on differential measurement. This platform for prostate cancer markers requires analytical validation (3) of the protocol of quantification. This step should be done by comparing the analytical results from the developed microsystem with those from the standard chemical analysis done in the medical laboratory. This lab-on-chip could also serve to measure the concentrations of certain elements in blood or biological tissues, as they provide a common basis for biosensors and only biochemical recognition changes from one detection to another.

Finally, we intend in the long term for a fast, simple, low-cost, and high-sensitivity analysis. This platform will be built with modern microfabrication techniques and should offer the possibility to monitor in real time prostate cancer markers content of an aqueous matrix for biomedical targets.

Outcomes (OCs) : What do we wish to achieve?	
OC1:	Fabrication of the microplatform with arrays of microelectrodes using simple and low cost processes
OC2:	Chemical functionalization of receptors for high specificity assay of prostate cancer markers
OC3 :	Evaluation of the performance of the Bio-platform analysis system in the clinical laboratory
OC4 :	Comparing the results obtain via the sensor to clinical laboratory results

References (R) (5 most recent peer-reviewed publications in the field)	
R1:	Catalona WJ. Prostate Cancer Screening. Med Clin North Am. 2018;102(2):199-214.
R2:	Mehrotra P. (2016). Biosensors and their applications - A review. Journal of oral biology and craniofacial research, 6(2), 153–159.
R3 :	Filella, X., Fernández-Galan, E., Fernández Bonifacio, R., & Foj, L. (2018). Emerging biomarkers in the diagnosis of prostate cancer. Pharmacogenomics and personalized medicine, 11, 83–94.
R4 :	Xu, L., Wen, Y., Pandit, S. et al. Graphene-based biosensors for the detection of prostate cancer protein biomarkers: a review. BMC Chemistry 13, 112 (2019).
R5 :	Åstrand AP, Andersson BM, Jalkanen V, Ljungberg B, Bergh A, Lindahl OA. Prostate Cancer Detection with a Tactile Resonance Sensor—Measurement Considerations and Clinical Setup. Sensors. 2017; 17(11):2453.