BOOK OF ABSTRACTS

1st TROPSENSE Workshop:

Tropical diseases and breath analysis

Gdansk – Poland, 9th February 2016

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Tropical diseases and breath analysis

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CHAIRS:

Dr. Mohamed Fethi Diouani (Institute Pasteur of Tunis, Tunisia)

Dr. Radu Ionescu (Rovira i Virgili University, Spain)

AGENDA:

9:00 – 9:20 **Dr. Fethi Diouani:** Welcome and Introduction

9:20 – 9:40 **Prof. Mourad Mokni**, Institute Pasteur of Tunis, Tunisia: "Cutaneous leishmaniasis: A bad travel memory, a neglected health problem"

9:40 – 10:00 **Prof. Raul Rodriguez**, University of Pamplona, Colombia: "Prevalence and incidence of Dengue in Colombia and in the Norte de Santander department during 2014 – 2015"

10:00 – 10:20 **Dr. Beata Szostakowska**, Medical University of Gdańsk, Poland: "Diagnostics of dengue, leishmaniosis and alveolar echinococcosis"

10:20 – 10:40 **Dr. Radu Ionescu**, Rovira i Virgili University, Spain: "Breath samples analysis: A non-invasive tool for diseases diagnosis"

10:40 – 11:00 **Mr. Giovanni Pugliese**, Rovira i Virgili University, Spain: "Breath sampling methodology"

11:00 – 11:30 Coffee Break

11:30 – 11:50 **Prof. Boris Mizaikoff**, University of Ulm, Germany: "Advanced Breath Analysis with IR Diagnostics"

11:50 – 12:10 **Dr. Jan Mitrovics**, JLM Innovation GmbH: "Breath analysis with chemical sensors"

12:10 – 12:30 **Dr. Grzegorz Jasiński**, Gdansk University of Technology, Poland: "Measurement procedures and signal processing for gas sensors"

12:30 – 12:50 **Prof. José Santiago Torrecilla**, Complutense University of Madrid, Spain: "Artificial Neural Networks Aiding in Breath-Based Early Cancer Diagnosis"

12:50 – 13:10 **Dr. Roxana Piticescu**, National Institute for Nonferrous and Rare Metals, Romania: "Combining physical and chemical deposition processes to fabricate organic thin films on silicon wafers based substrates"

13:10 – 14:00 Lunch

14:00 – 14:20 **Prof. Benachir Bouchikhi**, University Moulay Ismaïl, Morocco: "Exhaled Breath Analysis Based on E-Nose for Discriminating Chronic Kidney Disease, Diabetes Mellitus and Healthy States"

14:20 – 14:40 **Dr. Dumitru Ulieru**, SITEX 45 SRL, Romania: "New technologies based on microbiosensors for real time detecting and monitoring tuberculosis in group with increased risk potential"

14:40 – 15:40 Free discussion on the Perspectives of breath analysis for the diagnosis of tropical diseases (Chairs: **Dr. Mohamed Fethi Diouani** and **Dr. Radu Ionescu**)

ABSTRACTS

Cutaneous leishmaniasis: A bad travel memory, a neglected health problem

Mourad Mokni
La Rabta Hospital - Tunis – Tunisia

Abstract

Cutaneous leishmaniasis (CL) is an infection with parasitic flagellates of the genus *Leishmania*. It is usually a widespread zoonotic disease transmitted between wild and peridomestic animals, especially rodents and canines, mainly by *phlebotomus* sand flies, and from these reservoirs to man.CL is found in all countries of the tropical and subtropical regions of the world except New Zealand, Australia, and the islands nations of the pacific. Epidemiology of CL may be influenced by environmental Factors, demographic aspects, population migration, seasonal and climatic conditions. *Leishmania* species identification is mainly based on biochemical characters (isoenzymes) which have been exploited to establish numerical classifications. Molecular studies have given much new information on structure of the *Leishmania* genome, the study of the function of which is considered as a priority for understanding and solving several acute clinical problems, such as pathogenicity, tissue tropism, and drug resistance.Although each of the *leishmania* species may have its peculiar manifestations and areas of endemicity, yet none of the clinical manifestation is unique to a particular species because of considerable clinical diversity and overlap. Ulcero-crusted nodule and plaque are the main clinical presentations. All other clinical forms will be reviewed. The clinical picture is dependent on determinants related to the infecting species of *Leishmania* and the host. These include infectivity, virulence of the parasite, extent of lymphatic, siege of the lesions, immune response, and genetic susceptibility of the host. Clinical and histologic manifestations depend upon the strain of the organism, the size of inoculum, and the immunologic status of the individuals in the endemic or nonendemic areas.The natural history of leishmaniasis must be considered in therapeutic strategy. Lesions of CL heal spontaneously over 1 month to 6 years. Multiple therapeutic options had been considered over the years. Unfortunately, few have proven effective and withstood the test of time. To date, antimonials, both intralesionally and parenterally are demonstrably the most efficacious agents. Their toxicity, however, precludes indiscriminate use ans necessitates close medical observation. The enhanced interest in leishmaniasis over the past few years soon may yield less toxic, effective, orally administered agents and a protective vaccine.

Prevalence and Incidence of dengue in Colombia and Norte de Santander During 2010-2015.

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Abstract

Dengue is currently one of the major public health problems affecting half of the Colombian population, mainly women and children living in endemic cities. It is one of the most important emerging and reemerging diseases, whose determinants and immediate causes are linked to living conditions, urban sprawl, disorderly growth of endemic cities, the extensive trade and more frequent travel. The country has the adequate environmental conditions to transmit dengue, and it is estimated that the population at risk is about 24 million people, located mainly in the endemic municipalities. [1]

On the other hand, we must take into account the distribution of vectors of transmission of dengue in the country. The mosquito Aedes aegypti is present in almost all Colombian territory. This does not mean that all mosquitoes are infected, but the actual risk of getting the disease by the presence of the mosquito in the country is increased. The Aedes albopictus, is localized only in some areas of the country. [1] [2]

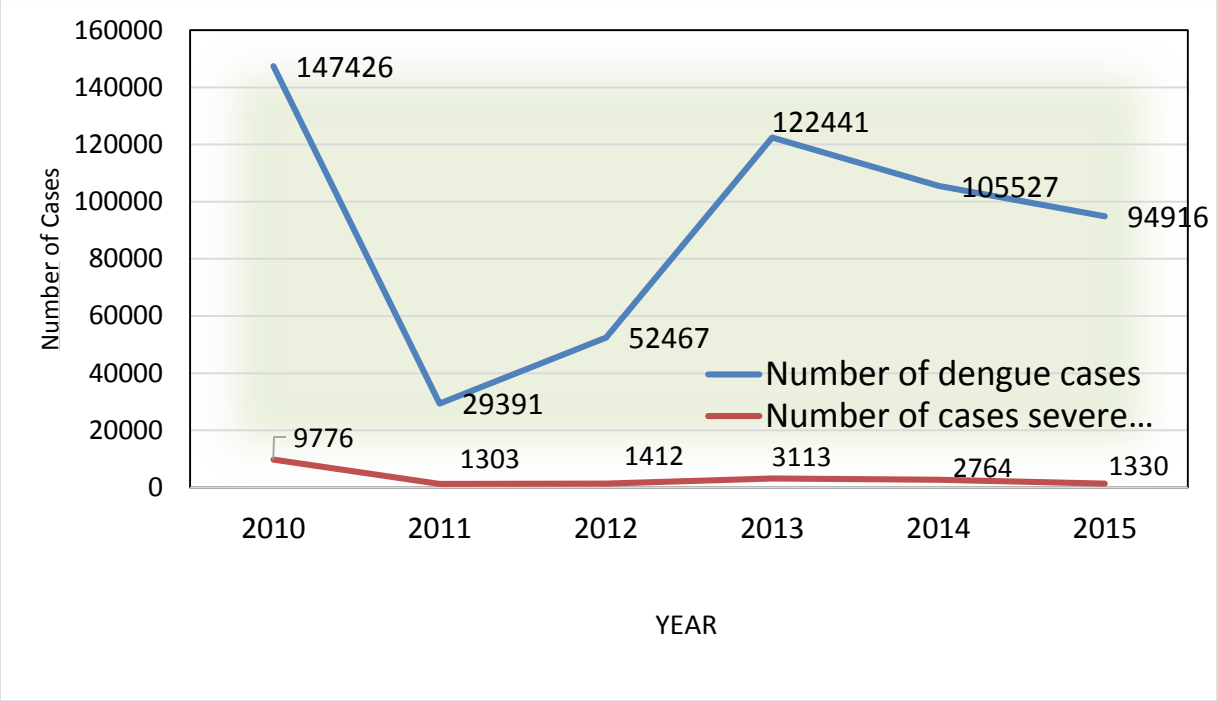
The dengue transmission in Colombian territory is intensified below an altitude of 1,800 meters. From the 1123 municipalities that has the country, the endemic municipalities that reported cases has passed from 390 in 1999 to 743 municipalities in 2010, which constituted an increase of 90.5% in the expansion of the transmission. In relation to the serotypes that cause dengue fever, currently there are circulating the four serotypes along the country. [3]

Epidemiological data show that the average annual number of dengue cases are about 100,000, as reported in 2015, and 1300 cases of severe dengue (haemorrhagic). The national incidence in 2015 was 355 cases per 100,000 population, and the population at risk corresponds to urban areas. The number of deaths from dengue epidemic outbreak in 2010 was 233 cases, while 2015 presented 72 deaths. [4]

In relation to the North Santander Department epidemiological data, in the period 2010-2015, around 38,500 cases of dengue were reported. 80.1% of the cases accumulated in the department were recorded in the municipalities of Cucuta (67.2%), Los Patios (7.1%) and Villa del Rosario (5.7%), belonging to the metropolitan area. The municipalities of Tibu Carmen, Convention Durania, Lourdes, La Esperanza, Bochalema, Cáchira and Gramalote were classified at very high risk because they had incidence rates between 705.5 and 1,486.3 per 100,000 inhabitants in the 2010-2015 period. [5] [6]

The mortality of dengue in the department of Norte de Santander is above that recorded in the country. Among the factors behind this phenomenon, it is the location of the department on the border with Venezuela. In this country there are increasing cases of dengue. Likewise Cucuta capital city, is the center of intense commercial activity and migration border with Venezuela; this rapid unplanned urban growth, simultaneous circulation of the four serotypes, high rates of infestation and eco-epidemiological conditions are favorable for transmission and persistence of dengue adds. [6] [7]

Figures



Number of cases of dengue and severe dengue in Colombia from 2010 to 2015.

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Diagnostics of dengue, leishmaniosis and alveolar echinococcosis

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Abstract

Dengue fever, leishmaniosis and alveolar echinococcosis are three diseases spreading rapidly in recent years. The range of occurrence of particular diseases is different. Dengue and leishmaniosis occur in tropical and subtropical countries, whereas alveolar echinococcosis occurs only in northern hemisphere. Etiological agents of these diseases are also different: virus (denga), protozoan (leishmaniosis) and tapeworm (echinococcosis). However, all they share a common trait: all are an increasing threat to the health of the population of Europe. Despite this, the knowledge about these emerging diseases in Europe is still low. A short characteristics of particular pathogens and the most important symptoms of diseases will be presented during the lecture. Methods used in the diagnosis of these diseases will be discussed, including their advantages and disadvantages.

Biography

Dr Beata Szostakowska, biology Doctor, Assistant Professor at Department of Tropical Parasitology, Institute of Maritime and Tropical Medicine, Medical University of Gdańsk, Poland. President of Gdańsk Branch of the Polish Parasitological Society, and Member of the National Association of Laboratory Diagnosticians. *Additional qualifications:* Diplomas in specialization in Microbiology and Parasitology, Certification of rights to perform duties of the laboratory diagnostician and to supervise laboratories carrying parasitological diagnostic research. *More important international collaborations:* 2002 – present: Abo Akademi University, Abo/Turku, Finland, working on fish parasites. Former: Centers for Disease Control and Prevention, Atlanta, Georgia, USA, working on molecular characteristic of malaria parasites. *Participation in international projects:* UE Program "The Centre of Bio-safety Research and Molecular Biomedicine (BioMoBil)", FP5 and FP6. Leonardo da Vinci Creation of multilingual continuing education programme by e-learning in Parasitology and Medical Mycology intended for Professionals working in non-specialized clinical laboratories – e-MEDICINimage. *Participation in international grants:* „Implementation of F*IS*H for Detection of Human Enteropathogenes", NATO Collaborative Linkage Grant, Johns Hopkins School of Public Health, Baltimore, USA; "An attemt to defeat the infection by *Henneguya zschokkei* in cultivated white-fish (*Coregonus lavaretus*) in fresh- and brackis-water regions in Finland",Grant of Åbo Akademi University, Åbo/Turku, Finland. Participation in 13 Polish projects sponsored by the Polish Ministry of Science and Higher Education (PMSHE) - Principal Investigator of 3, and Collaborator in 10 grants. *Most important achievements:* Optimization and implementation of molecular methods to diagnostics of parasitic diseases: amebosis, leishmaniosis, filariosis, malaria, echinococcosis, provided in Department of Tropical Parasitology, Medical University of Gdańsk, Poland; Detection of protozoan parasites: *Giardia intestinalis, Cryptosporidium, Acanthamoeba* in water reservoirs in northern Poland, genotype determination of *Acanthamoeba* isolates; Development of molecular methodology and evaluation of level of contamination of environment (soil, plants, water and air) with *Echinococcus multilocularis* eggs.

Breath samples analysis: A non-invasive tool for diseases diagnosis

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Abstract

The analysis of volatile organic compounds (VOCs) emitted through the breath is a promising approach for diseases diagnosis, prognosis, monitoring and the development of future personalized medicine [1]. The analysis of exhaled breath composition is attracting increased attention as a new frontier of non-invasive, patients-friendly and potentially inexpensive medical diagnostics procedure. The rationale behind the analysis of breath composition for the early diagnosis of a disease is that metabolomic changes occur in the human body at an early stage of the disease, which reflect changes in the blood chemistry produced by the disease, and are transmitted to the alveolar exhaled breath via the lung. As a consequence, some VOCs appear in the exhaled breath in modified concentrations as compared to the normal state and/or new VOCs are generated. These VOCs represent volatile biomarkers linked with the disease conditions.
Using analytical studies and electronic olfaction devices (arrays of cross-reactive nanomaterial-based chemical gas sensors), the metabolomics signature provided by VOCs released via breath can provide complementary information and improved diagnostic results. Metabolic profiling (i.e., identification of disease-related breath biomarkers) offers the possibility to observe biochemical effects produced by the onset of the disease in the organism, and represents a close approach to a biological end-point. The detection of an appropriate breath volatile biomarkers pattern employing electronic olfaction could enable early identification of the disease and the immediate prescription of an adequate treatment.
Importantly, every disease has its own volatiles fingerprint, therefore the presence of the target disease is not masked by other diseases [2].

References

[1] Y.Y. Broza, L. Zuri, and H. Haick, “Combined volatolomics for monitoring of human body chemistry”. Scientific reports, 4 (2014).
[2] J. Dummer, M. Storer, M. Swanney, M. McEwan, A. Scott-Thomas, S. Bhandari, S. Chambers, R. Dweik, M. Epton, "Analysis of biogenic volatile organic compounds in human health and disease", Trends Anal. Chem., 30 (2011) 960-967.

Brief biography

Dr. Radu Ionescu's research focuses on diseases diagnosis through volatile samples analysis. Dr. Ionescu is the Coordinator of the EU funded H2020-MSCA-RISE-2014 project "Development of a non-invasive breath test for early diagnosis of tropical diseases" – TROPSENSE (www.tropsense.eu). He is the PI of the research project “Detection via volatile organic compounds of tuberculosis, brucellosis and other disease in wild and domestic swine” funded by the United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). In 2015, Dr. Ionescu organised the Symposium "Approaches and Nanotechnologies for Volatolomics" (www.volasym.com).

Breath sampling methodology

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The VOCs in breath are at trace levels, therefore, any contamination or improper methodology may have a significant impact on their composition and concentration detected in exhaled air. This is a major issue in breath analysis. Now there are no accepted standardized methods for on-line or off-line VOC breath-gas sampling, blocking the introduction of breath tests into clinical practice. An effective capture of a breath sample requires minimizing interference from exogenous environmental VOCs and VOCs that do not originate from the alveolar region. The alveolar breath is the part of exhaled air in equilibrium with systemic blood, reflecting the metabolic processes occurring in the body. Breath-capture methods range from directly breathing into an analysis platform or the relatively simplistic collection within a suitable device (indirect sampling). Indirect sampling may be performed for a single sampling or for multiple sampling. However, the composition of a single sample may not be a representative alveolar gas sample for the reason that breaths may considerably vary from each other due to different modes and depth of breathing. Multiple sampling may be preferable in order to acquire reproducible breath samples. In this presentation we talk about the most used sampling devices, focusing the attention on the sampling bags and on the Bio-VOC breath sampler. We will show videos about the breath collection procedure with these devices and how to transfer the breath sample from these devices into a sorbet tubes, for a long time samples storage.

Figures

Brief biography

My name is Giovanni Pugliese I was born in Italy in 1988 and currently I am a PhD student of the Microsystems and Nanotechnologies for Chemical Analysis (MINOS) research group at University Rovira i Virgili, Tarragona, Spain.
I got my bachelor degree in chemistry in 2010 with high GPA (109/110) at the University of Calabria, Italy. During my bachelor thesis I learnt the principle of research by working on a rapid and sensitive assay of perfluorocarboxylic acids in aqueous matrices by headspace solid phase

microextraction–gas chromatography–triple quadrupole mass spectrometry under supervision of Prof. Antonio Tagarelli.
In May 2013 I obtained my master degree with honors in Chemistry at the University of Calabria (ITALY). During my Master's thesis, I worked on the development of a simple and rapid solid phase microextraction-gas chromatography-triple quadrupole mass spectrometry method for the analysis of dopamine, serotonin and norepinephrine in human urine under the supervision of Prof. Antonio Tagarelli.
My research interests are focused on the development of innovative analytical methods for biomedical applications, as biomarkers discovery, by analyzing different samples of biological and environmental interest.
My main research activitiy in the TOPSENSE project is the identification by GC/Q-TOF of breath volatile biomarkers associated with three tropical diseases: Hydatidosis, Leishmaniasis and Dengue.

Artificial Neural Networks Aiding in Breath-Based Early Cancer Diagnosis

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Inspired by the actual structure and mechanism of biological neurons, artificial neural networks (ANNs) were created and have become a relevant part of computational artificial intelligence [1]. ANNs are a set of non-linear algorithms that have been successfully implemented for countless applications as they can be trained to originate highly reliable mathematical models that are able to act as, for instance, classifiers or estimators. These algorithms have been used to carry out numerous tasks in many fields ranging from industry to economics, all the way to biomedicine. In this last context is where the present research is centered and, specifically, to aid in the analysis of the data that is produced during breath analysis for cancer diagnosis.

Our research group, which excels in the design and optimization of ANN-based models, collaborates in two projects which are focused on the early diagnosis of cancer. These projects are LCaos, which is primarily centered on lung cancer, and Volgacore, which focuses on gastric cancer. One of the main goals of these projects is to reach early diagnosis of cancer through breath analysis, as it has been shown in the past that human metabolism or clinical state are somewhat reflected in the endogenous volatile organic compounds (VOCs) present in exhaled breath [2,3].

During these projects, different methodologies have been employed to extract the underlying information that breath contains, leading to large databases that require complex mathematical treatment. This is where ANNs come into play, as they have been used to interpret this information and create useful mathematical tools for various applications. For example, they have been successfully trained to perfectly identify and accurately estimate the concentration of a set of polar and non-polar VOCs (comparable to those present in breath samples), individually or in mixtures, at low concentrations which were measured using cross-reactive silicon nanowire field-effect transistor sensors [4]. On the other hand, the data resulting from a study carried out with proton transfer reaction-mass spectrometry, which was used to measure the exhaled breath samples of lung cancer patients and healthy controls, was modeled with ANNs to create a classifying tool to distinguish both groups (correct classification rates were over 90%). Finally, recent results indicate that using ANNs to model databases obtained from the breath analysis of different gastric cancer patients and high- and low-risk groups, using gold nanoparticle-based cross-reactive sensor arrays, is a suitable alternative as well, as a successful preliminary analysis has been carried out, with high classification rates.

References

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Brief biography

Professor of the Chemical Engineering Department of the Complutense University of Madrid, he received his Ph.D. with honors in Chemical Engineering in 2000. In 2005, he obtained his Advanced Technician in Occupational Risk Prevention Degree. Modeling complex systems and designing chemometric tools for many fields such as health, engineering, and food technology is the main focus of his research. He collaborates with many universities and national and international research groups

Combined physical and chemical deposition processes to fabricate organic thin films on Si wafer based substrates

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Abstract

Over the past three decades, electrochemical biosensors have attracted researchers' interest because of their special electronic, optic and mechanical properties [1, 2]. Different methods have been used to prepare nanostructured thin films for potential use as biosensors. Among fabrication routes, we mention the following: i) solid-phase-incorporated-reagents (SPHINER); ii) novel ex situ and in situ approaches: In the ex-situ approach, metal nanoparticles are first produced by soft-chemistry routes and then dispersed into polymeric matrices, while in in-situ approach, metal nanoparticles are generated inside a polymer matrix by decomposition or chemical reduction of a metallic precursor dissolved into the polymer; iii) controlled pyrolysis method in gaseous or liquids phase at isothermal conditions; iv) interaction of metal nanoparticles with nanostructured polymer through its functional groups; v) Ion implantation; vi) sol-gel method; vii) Miscellaneous methods such as layer-by-layer self assembly, layer-by-layer deposition.

In the present study, we propose the fabrication of nanostructured thin films based on $Si/SiO_2/Ti/Au$ and different commercial polymers such as poly(acrylic acid), poly (acrylic acid sodium salt), and poly(ethyleneimine), using a combined approach: thermal evaporation and hydrothermal-electrochemical deposition. Thus, gold nanoparticles were deposited on Si/SiO_2 wafers using thermal evaporation and then used as substrates in hydrothermal-electrochemical deposition of water soluble polymers. Surface properties of the resulted thin films were characterized using Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) and Fourier Transform Infrared Spectroscopy (FT-IR). Characteristics of the fabricated thin films will be used as a feed-back to improve hydrothermal-electrochemical process for future fabrication of thin films with potential use as biosensors for volatile organic compound detection in breath samples.

Figures

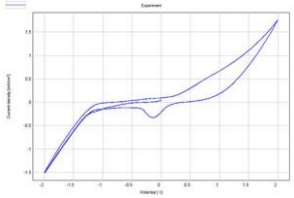

Figure 1. Potential Cyclic Voltammetry (100 mV/s)

References

[1] Y. Song, Y. Luo, et al, *Recent advances in electrochemical biosensors based on grapheme two-dimensional nanomaterials*, Biosensors and Bioelectronics 76 (2016) 195–212.

[2] S. Prakash, T. Chakrabarty, et al, *Polymer thin films embedded with metal nanoparticles for electrochemical biosensors applications*, Biosensors and Bioelectronics 41 (2013) 43–53.

Brief biography

Cosmin Petrica is PhD student in the field of biosensors. **Arcadii Sobetkii** is PhD student in the field of physical deposition methods. **Laura Madalina Popescu** is experienced researcher responsible with hydrothermal synthesis and FT-IR analyses. **Roxana Mioara Piticescu** is Scientific Director and project responsible from IMNR. She has expertise in hydrothermal synthesis of nanostructured powders; nanostructured films by electrochemical deposition and spin-coating; nanostructured composite materials; thermodynamic predictions. She coordinated more than 15 national projects from which 3 in the field of dental implants and biosensors, participant in FP 6 and FP7 projects.

Exhaled Breath Analysis Based on E-Nose for Discriminating Chronic Kidney Disease, Diabetes Mellitus and Healthy States

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Abstract

Volatile organic compounds (VOCs) in the exhaled breath have long been an area of interest for biomedical monitoring as a non-invasive indicator for the status of various health parameters. Hundreds of VOCs have been detected in the human breath, some of which are correlated to a variety of diseases. The aim of this work was to explore the possibility of using a sensor array coupled with appropriate pattern recognition methods to differentiate the exhaled breath samples on the basis of VOCs. A total number of 42 subjects have participated to this study. The study population included 3 groups of subjects based on current standard diagnostic of the Hemodialysis Center of Provincial Hospital of Khemisset, Morocco: 14 patients having Chronic Kidney Disease (CKD), 6 patients with Diabetes Mellitus (DM), and 22 Healthy States (HS). For all patients admitted to the study, breath and urine samples were collected. Exhaled breath was collected in duplicate, and analyzed by the E-nose. Urine samples were collected to determine the urinary creatinine concentrations by Jaffe's method. The E-nose data analysis by PCA has shown that it is possible to discriminate, with high accuracy (96.02 %), the exhaled breath among four distinct clusters corresponding to CKD patients, DM patients; and furthermore, to HS subjects depending on the urinary creatinine concentrations (see Fig. 1). Based on an array of electronic gas sensors, an odor recognition system was developed for potential screening, and early detection of renal impairment. However, more clinical validation with E-nose system is needed in hospitals where patients with cancerous diseases are treated.

Figures

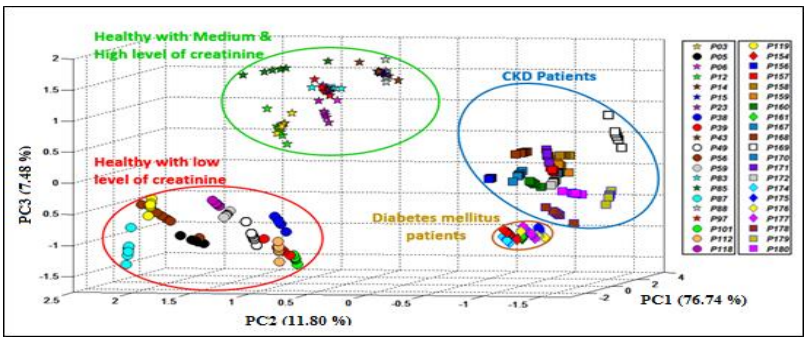

Figure 1: *PCA plot performed on 42 exhaled breath samples by using E-nose system (Score plot: 96.02 %)*

Brief biography

Benachir BOUCHIKHI received a position of titular professor at the University of Moulay Ismaïl, Faculty of Sciences in Meknes, Morocco since 1993. He is the director of the Laboratory of Electronics, Automatic and Biotechnology. His current research focuses on the development of electronic nose and electronic tongue devices for food, biomedical, and environmental monitoring. He is author and co-author of over 65 papers, published on international journals. He is member of the H2020-MSCA-RISE-2014 Project TROPSENSE: "**Development of a non-invasive breath test for early diagnosis of tropical diseases**".

New technologies based on microbiosensors for real time detecting and monitoring tuberculosis in group with increased risk potential.

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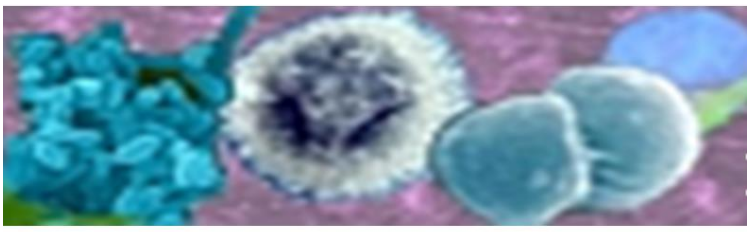
Abstract

The main purpose of the paper is the presentation of potential technologies concept experiments and results that could allow the achieving a family of integrated piezoelectric micro biosensors, able to detect tuberculosis (Mycobacterium) in real time and to be used for monitoring the groups with high risk to fall ill, by testing in their own habitat.
The detection will be made in liquid or/and gaseous environment.
The testing technique on subjects is a non-invasive one.
These desiderata impose three research directions: obtaining the optimum piezoelectric substrate, obtaining the microsensor layout and of execution technology, obtaining the sensitive materials.
All these will be compatibilized for functionalizing the micro biosensor.
The paper will present the obtained of monocrystalline piezoelectric substrates and some nano or micro structured layers of piezoelectric materials for an optimal response of micro sensors (sensibility, selectivity and minimal chemical reaction to interaction with antigens and antibody);
The projection a micro sensors family with different geometries (lay-out) optimized for improvement of sensors sensibility. The further works refer at how could be realized a matrix structure witch allow to be separate Mycobacterium in the two critical forms for human (tuberculosis and bovis);



Brief biography

Occupation or position held R&D Director, International cooperation and Business Development Mgr.

SITEX 45 SRL

- Design ,development and engineering, prototyping and microproduction of micro/nanosensors and sensors arrays, microsystems MEMS/MOEMS. actuators and transducers. microfluidics devices and smart systems integration for analytical instrumentation and metrological measurement for environment chemical and biochemical applications.

- Advanced researches and studies for micro/nanotechnologies applications for microsystems /sensors, microelectronic and optoelectronics components, photonics and micro-optics devices
- R&D cooperation activities under partnership of national and international projects as partner and coordinator, projects management and coordination of dissemination and promotion of results
- New and innovative products development by nanotechnologies applications design and development for. unconventional technologies for nanostructured materials processing and economic efficiency increasing by energy saving and environment protection,
- Research and development of modern chain manufacturing chains for industrial production,
- Research and development of micro and nanotechnologies applications for processing of high performance materials including nanostructured (nanoparticles, nanowires, CNT`s etc) for industrial application of micro/nanosystems and micro/nanosensors.for nanomedicine and environment monitoring, Wireless sensors networks for environment and health control and monitoring.
- Ultraclean systems design, validation and consulting services of microenvironment monitoring for cleanroom and microcontamination control for ultrapure and aseptic industries.

Advanced Breath Analysis with IR Diagnostics

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Abstract

In recent years, chem/bio sensing platforms increasingly benefit from miniaturized and integrated optical technologies providing direct access to molecular information. Since in-situ analytical strategies are becoming more prevalent e.g., in harsh environments or for point-of-care diagnostics, detection schemes that do not require reagents or labels are of particular interest providing localized on-site information in – or close to - real-time.

Mid-infrared (MIR; 3-20 µm) sensor technology is progressively more adopted in environmental analysis, process monitoring, and biodiagnostics owing to the inherent molecular specificity. Thereby, discrimination of molecular constituents at ppm-ppb concentration levels in condensed and vapor phase media is enabled. While recently emerging technologies include innovative waveguide structures such as mid-infrared transparent fiberoptics, substrate-integrated hollow waveguides, and planar semiconductor waveguide, the true revolution in MIR sensing is based on next-generation laser light sources - broadly tunable quantum cascade lasers (QCLs). Given these developments, compact yet robust MIR chem/bio sensors and diagnostics are on the horizon for applications in extreme environments such as the deep sea, but also for advanced breath monitoring in clinical analysis. Selected examples and recent developments will highlight the potential of QCL-based MIR sensing technologies.

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Short Biography

Dr. Boris Mizaikoff joined the faculty at the University of Ulm, Germany, as a Chaired Professor and Director at the Institute of Analytical and Bioanalytical Chemistry in 2007 with prior appointments at the Vienna University of Technology (Austria), and at the Georgia Institute of Technology (USA). His research interests focus on optical chem/bio sensors, tailored (bio)molecular recognition interfaces, molecularly imprinted materials, system miniaturization and integration, and multifunctional (nano)analytical techniques with applications in environmental analysis, process monitoring, and biomedical diagnostics. He is author/co-author of >230 peer-reviewed publications, 16 patents, and numerous invited contributions at scientific conferences. Since 2010 he is Associate Editor Europe of *Analyst* published by the Royal Society of Chemistry (RSC), and since 2014 Editorial Advisory Board member of *Analytical Chemistry* published by the American Chemical Society (ACS). Awards include the 2010 *Craver Award* (Coblentz Society), the 2005 *Pittsburgh Conference Achievement Award* (Society for Analytical Chemists of Pittsburgh), the 2004 *Fritz Feigl Award* (Austrian Society of Analytical Chemistry), and the 2004 *Meggers Award* (Society of Applied Spectroscopy). In 2005, he was elected *Fellow of the American Association for the Advancement of Science (AAAS)*, and in 2013 *Fellow of the Royal Society of Chemistry (RSC)*. In 2014, he has been named *Fresenius-Lecturer 2014* by the German Chemical Society (GDCh).