The high number of deaths caused by multifactorial diseases (lung cancer – LC, respiratory diseases, cardiovascular disorders and infectious diseases) is mainly due to late diagnosis, which limits effective treatment and significantly increases the cost of patients care. In recent years, disease diagnosis has been directed towards rapid, simple and non-invasive methods based on the detection of volatile organic compounds (VOCs) and characteristic VOC profiles as diagnostic markers that arise from disease processes that alter normal physiological and metabolic pathways. There is a continuously growing interest in methods for analyzing exhaled breath (EB), which containing VOCs, e.g. aldehydes, nitric oxides, sulphur oxides, *etc*. Effective detection at an early stage of disease markers can result in an early diagnosis at the initial states and referral of the patient for further testing to exclude or confirm the disease. In addition, EB analysis can also be useful for monitoring airway inflammation and selecting appropriate drug treatment. The low availability of non-invasive methods for monitoring and identifying LC, among other conditions, has prompted the development of techniques that allow breath analysis to determine odour profiles, so-called 'fingerprints'. This is a rapidly developing field that has potential clinical impact and may offer opportunities for early detection of multiple diseases, *e.g.* asthma, obstructive chronic disease, lung cancer, interstitial lung disease, systemic diseases or other lung diseases. Rapid diagnosis of LC is highly desirable, as conventional methods such as chest radiography, sputum cytology, biopsy, or CT scan prevent such screening of a wide range of populations. Most often, stages are diagnosed where treatment is already difficult and ineffective due to late diagnosis. Therefore, the need for effective and rapid tools for the early detection of LC through non-invasive patient breath analysis is both critical and urgent.

The gold standard in analytical approaches for biomarkers detection is still the combination of gas chromatography and mass spectrometry, where limits of detection are at ppb/ppt. However, due to the disadvantages of classical techniques for the analysis of volatile biomarkers, *i.e.* having trained personnel, costs of sample preparation, analysis and equipment; the current trend is towards the development of biosensors as non-invasive and rapid diagnostic tools. Since Clark's invention in the 1950s, which became a milestone that started the introduction of biosensors into medical practice, their significant development can be observed. However, despite several decades of development, their practical application in disease diagnosis is still in its infancy, with biosensors requiring significant improvements to become accurate diagnostic tools. In line with efforts made by the World Health Organization, crucial criteria have been introduced to improve the effectiveness of early diagnosis with use of biosensors. Affordability, sensitivity, specificity, user-friendliness, speed, durability and accessibility were listed as the basis for evaluating tests for disease diagnosis. Bioelectronic nose devices, consisting of a biosensor array, which are being introduced into analytical practice, seem to be ideal solution to meet most of the requirements. The critical element for the construction and effectiveness of the biosensors is the appropriate design of the bioreceptor part, so that biomarkers can be detected at sufficiently low concentration levels with high specificity and selectivity. Successful implementation is dependent on developments in biotechnology, micro/nanotechnology, electronics, supramolecular chemistry, computational techniques, all of which enhance the metrological performance of biosensors so that they can be more useful in disease diagnosis. The biosensors that our team designs, use biomimetic materials such as peptides, which aim to mimic olfactory receptors, including odorant-binding proteins found naturally in insects. They do not require a tertiary structure or lipid membrane, which improves their stability, durability and reproducible production. Using molecular modelling, peptides mimicking the binding sites (so-called binding pockets) in odorant-binding proteins will be designed. The biosensors constructed based on the newly synthesized biorecognition elements will be tested against selected VOCs identified as biomarkers. The next stage of the project will be the construction of mobile bio-enose, which should enable rapid collection of a breath samples and detection of biomarkers. Successful application of the biosensor arrays requires the design of appropriate recognition elements and their integration with transducers to produce an easily measurable analytical signals. The design and construction of biosensors based on biomimetic materials that enable the analysis of breath samples for biomarker detection may in the near future result in viable applications in the healthcare industry, including disease diagnosis. The project aims to develop highly sensitive and selective biosensors to detect low concentrations of target molecules present in exhaled breath, which could be a promising diagnostic tool for detecting various diseases. The project is expected to increase knowledge in diagnostics and therapy. Special interest may show diagnostic companies that are looking for new diagnostics tools with interest for commercialization.