According to data provided by the WHO (*World Health Organization*) an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. Currently, the number of diabetes patients is believed to be over **500 million and is predicted to increase to 629 million by 2045**. Furthermore, the estimated number of undiagnosed sufferers is around 212 million and 352 million people are at risk of developing type 2 diabetes. Diabetes is defined as a group of metabolic disorders in which there are high blood-sugar levels over a prolonged period. When diabetes is not well managed, it can cause other complications such as: heart attack, nerve damage, blood vessel damage, blindness, kidney failure, stroke and death. However, low blood-glucose concentration can occur in all types of diabetes as well and it may result in seizures or loss of consciousness. This may happen after too long a period of fasting or exercising more than usual. On the other hand, high blood-glucose concentration has been the reason for several car accidents in which drivers have lost consciousness because they had undiagnosed diabetes. Uncontrolled diabetes during pregnancy can have a devastating effect on both the mother and the child, substantially increasing the risk of infant fatality, congenital malformations, stillbirth, prenatal death, obstetric complications, and maternal mortality. Diabetes caused 1.5 million deaths in 2012 and 1.6 million in 2016. Higher than optimal levels of blood glucose caused an additional 2.2 million deaths, by increasing the risk of cardiovascular and other diseases. The first step to a healthy life with diabetes is an early diagnosis. Over the last few years, the measurements and diagnostics of diabetes have not changed much. It still is based on blood-glucose measurements as a gold standard in medicine. Type 1 diabetes often presents symptoms that prompt the patient to make contact with health services while type-2 diabetes can go undiagnosed for many years, yet it can still influence the patient's health condition. Therefore, the prevention of diabetes complications should be focused on screening tests. Because of this, the screening tests should be cheap, easily accessible and meet current International Standardization Organization (ISO) standards for capillary blood-glucose measurements. This need has created a research area where novel devices for rapid blood-glucose measurements are the subject of research, including the innovative detection of exhaled biomarkers. Therefore, the **goal of the project is to carry out fundamental research focused on the development of microwave-based gas sensors with gas-sensitive layer based on the various metal oxides for gas sensors' applications, i.e. for selective detection of various volatile organic compounds (VOCs) present in human breath.** The major goal of the project is to develop a microsystem based on microwave gas sensors array covered by dedicated metal oxides such as CuO, $SnO_2$, $WO_3$, ZnO, $In_2O_3$ and their modifications including doping by noble metals as well as by utilizing the homo- and heterostructures to obtained enhanced sensitivity and selectivity to various volatile organic compounds present in exhaled human breath. *Additionally, the project will focus on the theoretical aspects of the gas-sensing mechanism between the metal oxide gas-sensitive layers and target gas molecules in the microwave frequency range*, where various microwave circuits will be used including resonant and broadband designs. To achieve that goal, an interdisciplinary team has been established which combines the researchers that over last years have been constantly carrying out research focused on the development of novel microwave circuits, measurement techniques in the microwave frequency range, development of gas-sensitive layers based on the metal oxides. The microsystem will be used to detect and analyze the concentrations of biomarkers that are present in the exhaled human breath, such as acetone, ethanol, propane. T**he essence of the project is to investigate whether it is possible to develop the microsystem to detect biomarkers in human breath using the microwave gas sensors array.** Moreover, **there is a lack of experimental results that are necessary for delivering the gas-sensing mechanism between the gas-sensitive layer and target gas molecules at microwave frequencies. Therefore the tasks within in the project are planned to carry out the fundamental experiments that allow the authors to deliver the interaction model.** It should be pointed out, that <u>without the theoretical modeling supported by experimental verification</u> the microwave-based gas sensors will never be an attractive alternative to the resistance-based sensors, which are constantly investigated.