The project concerns the analysis of sensor properties of mixed copper and titanium oxides thin films prepared by magnetron sputtering. Sensors based on metal oxides, e.g. tin, tungsten, titanium, copper or nickel oxides, are one of the types of sensors for detecting explosive and harmful gases. The detection process is possible due to the phenomenon related to change in resistance of the thin film caused by adsorption/desorption of gases on the oxide surface. Thick film gas sensors based on tin oxides have been produced since the 1970s, but a new generation of thin film gas sensors emerged at the beginning of the 21st century. Nanosensors exhibit better sensing ability due to their larger active surface area, and they also exhibit more stable performance than their thick film counterparts. For this reason, nanometric structures such as thin films, nanowires, nanowires of one material decorated with nanoparticles of another, or core-shell structures are often used in the design of new sensors. In the literature, much attention has been given to the study of mixed oxides with different types of conduction, which may exhibit better properties than single oxides. However, so far, heterostructures based on copper and titanium oxides are poorly investigated. Therefore, the aim of the project is to deposit thin films of various mixed copper and titanium oxides in which the proportions of the individual oxides will vary from 0-100% (e.g. 30% copper oxide and 70% titanium oxide) and determination their specific properties.

As part of the project work, extensive research will be conducted to develop a universal gas detection model using the proposed materials. For this purpose, measurements will be performed using gases of different properties (e.g. hydrogen, ethanol, nitrogen oxides) at different concentrations in air. Diverse structures and surface morphologies obtained by appropriate design of material composition and thermal post-processing parameters will also be studied. Moreover, optimal sensor operating conditions such as operating temperature will be established.

By providing in-depth analysis of the sensor response correlated with surface chemistry, phase type and size, surface morphology, and electrical properties, the authors will recommend the method of fabricating mixed copper-titanium oxide thin films with the best sensing properties. Moreover, analysis of further properties, e.g., optical properties, will allow to determine the possibility of manufacturing multifunctional thin films, which will be simultaneously characterized by e.g. high transparency and ability to detect various gases.