

Gas sensors for many years are integral to various industries, like hydrogen-powered transportation, pharmacy, food and agriculture where they are used for detecting gases like hydrogen, ammonia, acetone, or volatile organic vapor, e.g. ethanol. Typically they rely on single-layer construction, where material properties alter upon exposure to specific gases.

The project aims to develop a description of the mechanisms that determine the properties of hybrid sensors structures. Particularly the scientific goal of the project will be demonstrated through the utilization of the WO_x-CeO_y bilayer sensing system. The main focus is placed on elucidating the role of the interface area at the border of two sensing materials and understanding how the response mechanism is intricately linked to its properties. This involves in-depth in-situ studies, a crucial and original component of the proposed research.

Proposed approach opens new paths for potentially reducing the operating temperature of the hybrid sensor compared to conventional ones, enhancing its practicality. Additionally, the use of two different yet compatible microelectronic technologies for oxide layer deposition (magnetron sputtering and atomic layer deposition) offers the possibility of obtaining diverse properties in the deposited materials. The incorporation of advanced in-situ spectroscopic techniques further addresses the intricate interaction of selected gases with the surface of the fabricated sensor, providing a comprehensive understanding of the sensing mechanism.

The project will result in (1) determining the role of the bilayer interface in the detection of selected gases, (2) evaluating the influence of surface properties and morphology on selectivity and reaction time, (3) determining charge transfer mechanisms in WO_x/CeO_y heterostructures. The results will be widely communicated through publications in recognized high-impact journals, dissertation chapters, development of the basis for a joint project within the framework of European initiatives and, in the future, further transfer of the acquired knowledge to practical applications.