

# Novel Identification and Sensing Approach based on Nanomaterials and MIMO Technology for Confined Environment and Oil and Gas drilling sites.

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The steadily growing Radio Frequency Identification (RFID) technology requires an ever-improving performance of the RFID systems, becoming necessary for all applications, ranging from space to underground environment. There has been a vast effort towards combining the capabilities of a sensor and RFID so as to sense, process data, and transmit information about objects/personnel. The overall objective of this project is to develop a new RFID sensor based on carbonaceous nanomaterials such as carbon nanotubes (CNTs) and graphene, decorated with metallic nanoparticles. The RFID will first be used as a highly sensitive sensors against various gases, including carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), hydrogen chloride and hydrogen sulfide (H<sub>2</sub>S), for which the mechanism is based on chemical adsorption that produces changes in nanomaterial properties such as DC resistance and/or effective dielectric constant. Second, the RFID sensors will be then combined to the MIMO technology (Multiple-input Multiple-output) to enhance the data rate, the reliability, and the range of the backscatter link, based on their ability to turn multipath propagation. By combining expertise in surface science, nanomaterials, sensors and RF/wireless communications technology, with advanced nanoscopic analysis that offer special opportunities for developing new characterization tools, this project aims to improve and optimize the performance of RFID/MIMO sensors systems by providing a fundamental understanding of the factors responsible for their high performance in confined environments (tunnels, subway, deep excavation, airport, port, industrial area, and any confined area). The proposed approach includes analytical techniques supported by calculations and modeling, as well as testing under harsh environment conditions, which will be specifically implemented to reproduce the operating environment of confined galleries. Our goal is to develop prototype devices for use by industrial partners. The main challenges we want to address through collaboration between one academic and two industrial partners are the integration of nanocarbon based-RFID for the development of a sensor node for CO, SO<sub>2</sub>, HCl and H<sub>2</sub>S toxic gases detection, and breathing-gas content estimation, their stabilization in harsh environments and their integration with MIMO technology to increase the reliability and throughput.