Colorimetric and Electrochemical Sensors for Chemical and Biological Sensing

Asst. Prof. Yardnapar Parcharoen, Ph.D.

Given the critical need to develop rapid, accurate, cost-effective, and on-site methods for early detection of chemical and biological analytes in the healthcare sector, various sensors have been reported. This lecture aims to provide an overview of our team's developments in colorimetric and electrochemical methods for detecting environmental, clinical, and food-related compounds. By integrating diverse principles and innovations, these sensors promise heightened sensitivity, accuracy, and real-time monitoring capabilities.

Colorimetric sensors have found widespread use in detecting numerous analytes due to their cost-effectiveness, high sensitivity, specificity, and clear visibility, even with the naked eye. In recent research, the emergence of advanced nanomaterials, such as silver nanoparticles (AgNPs), significantly improves the development of colorimetric sensors. This lecture focuses explicitly on the recent advances made between 2019 and 2023 in the design, fabrication, and applications of colorimetric sensors.

Electrochemical sensors involve electrochemical processes, translating molecular interactions into electrical signals. Their exceptional precision and speed in identifying analytes have driven advancements in accurate detection methodologies. The development of electrochemical sensors encompasses breakthroughs in materials, design, and fabrication techniques, including AgNPs, silicon carbide, multi-walled carbon nanotubes, and chitosan nanoparticles. Through the fusion of nanotechnology and novel signal transduction methods, these sensors exhibit enhanced selectivity and sensitivity, enabling the detection of an extensive array of substances, including pollutants, biomarkers, and pathogens.

Finally, the drawbacks and advantages of each type of sensor are identified and discussed, followed by a relevant discussion on existing challenges and prospects.