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ICMSN-2025

8th International Conference on

MATERIALS SCIENCE & NANOTECHNOLOGY

Jun 25-26, 2025 at **Prague, Czech Republic**
(Hybrid Event)

Venue: Hotel Duo
Address: Teplická 492, 190 00 Prague 9, Czechia

Magnetic nanoparticle-enhanced pathogen detection on patterned gold-leaf electro-chemical biosensor

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Nanomaterials and nanoparticles significantly enhance biosensor technology by improving sensitivity, selectivity, and detection efficiency, and open new pathways for developing highly specific and innovative biosensor platforms. Their high surface area-to-volume ratio, unique optical and electronic properties, and ability to be easily functionalized make them suitable for interacting with biological molecules like enzymes, antibodies, or aptamers.

On the other hand, electrochemical biosensors are essential tools for achieving rapid and specific detection in areas such as healthcare, environmental monitoring, and food safety [1-3]. Gold electrodes are widely used due to their stability, conductivity, and ability to bind biomolecules through thiol chemistry, making them ideal for immobilizing biorecognition elements [1]. This study introduces an affordable and scalable approach to fabricated gold leaf electrodes (GLEs) with different patterns using laser ablation for precise patterning of different geometry [1]. Unlike traditional deposition or printing methods requiring cleanrooms and expensive equipment, this approach reduces costs, chemical waste, and substrate damage risks, offering precise geometry and dimension of electrodes. Commercial Pathatrix™ Dual APD50 magnetic nanoparticles functionalized with antibodies for the detection of Salmonella and Listeria are combined with patterned electrodes to detect the presence of these two pathogens. The surface and electrochemical properties of patterned GLEs with nanoparticles were characterized via scanning electron microscopy, cyclic voltammetry, and electrochemical impedance spectroscopy. Results demonstrated that utilizing magnetic functionalized nanoparticles on patterned electrodes can enhance the sensitivity of sensors achieving detection limits of 10^1 cfu/mL for both pathogens. The biosensor characteristics were tested in complex matrices, showcasing linear responses and good sensitivity.

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https://doi.org/10.1109/SENSORS56945.2023.10325027

Biography:

Dr Radonic received a PhD in electronics in 2010 at the University of Novi Sad. He authored and co-authored 3 book chapters, 30 journal papers, more than 60 conference papers, and 3 patent applications. Dr Radonić led and participated in a number of research FP6, FP7, H2020, Horizon Europe, COST, EUREKA, IPA projects, and 4 industrial projects. He gains experience and expertise during research and training programs at several universities: Harriot Wat, Edinburgh, Stellenbosch University, Saint-Petersburg Electrotechnical University "LETI," Technical University of Wien, INRAE, France. From 2022, he is the assistant director for science at BioSense Institute. The main expertise of Dr. Radonic is microfluidics, sensor development, electronic, fabrication technologies, measurements and characterization.