

Plenary 2

Frontier Bioelectroanalytical Technologies: Revolutionizing How We Sense Health

Susana Campuzano (1,2), Víctor Ruiz-Valdepeñas Montiel (1), Rebeca M. Torrente Rodríguez (1), María Gamella (1), Verónica Serafín (1), Ana Montero-Calle (2), María Pedrero (1), Rodrigo Barderas (2,3), José M. Pingarrón (1)

(1) Department of Analytical Chemistry, Faculty of Chemical Sciences, Complutense University of Madrid, Pza. de las Ciencias 2, Madrid-28040, Spain

(2) CIBER of Frailty and Healthy Aging (CIBERFES), Carlos III Health Institute, Madrid-28046, Spain

(3) Chronic Disease Programme, UFIEC, Carlos III Health Institute, Majadahonda, Madrid-28220, Spain

susanacr@quim.ucm.es

Advanced, reliable, and multifunctional (bio)electroanalytical technologies are increasingly demonstrating their potential to drive cutting-edge research and enable personalized healthcare. Beyond their already established analytical capabilities, they are expanding into new domains, thereby bolstering confidence in the transition toward sustainable, efficient, and data-driven healthcare systems [1].

These advances have been achieved through interdisciplinary collaborations. Specifically, the development of bio-inspired synthetic recognition elements - such as phage-displayed peptides, proteoforms by alternative splicing, protein ectodomains by directed mutagenesis, and full-length proteins in mammalian cells [2] - have greatly expanded the molecular toolkit for biosensor applications.

At the same time, considerable efforts have been devoted to the rational design and functionalization of (nano)materials with electrocatalytic, pseudoenzymatic, antifouling, and biomolecule-anchoring properties which act as signal-amplifying nanolabels and electrode modifiers, improving the sensitivity, selectivity, and stability of bioelectrochemical systems [3,4].

This plenary lecture will highlight the latest advances in robust, multiplexed, and multi-omics (bio)electroanalytical platforms that combine high throughput with smart, cost-effective design. Emphasis will be placed on their integration with complementary disciplines, such as proteomics [5] and bioinformatics, fostering a powerful interdisciplinary convergence. This synergy is transforming biomarker discovery and validation, enabling the identification of clinical actionable molecular signatures across multiple omics levels, including unexplored [6] and overlooked [7] targets - while advancing their interactome characterization. By bridging fundamental science and real-world applications, these technologies facilitate accurate detection in complex settings accelerating the shift toward truly personalized medicine.

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