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Strategies for decentralizing clinical, food and environmental (bio)electroanalysis

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(Bio)chemical analysis is rapidly progressing towards its decentralized version. This is an important milestone in the evolution of Analytical Chemistry, similarly to what happened when Instrumental Analysis emerged, or when Flow Injection Analysis appeared to automatize many analytical methodologies. All the milestones incorporated important advantages. Moreover, the integration with computers, both as active and passive interfaces, and the advances in materials and technologies, have given way to a new generation of tools and methodologies. Now, it is time for the decentralization of the analysis in all fields. In this context, electroanalysis is in its gold era. Miniaturized potentiostats, together with adaptable electrochemical cells, are playing an important role in this change. In addition, the simplicity of the procedures not only moves lab developments towards field applications but also allows obtaining information by everyone at any time. In turn, this would be converted into valuable knowledge-based decisions.

In this work, examples of electroanalytical platforms for application in the main fields of the analysis are presented. Apart from traditional cells, devices based on low-cost materials such as paper or transparency films combined with mass-produced materials such as pins, or pencil leads for out-of-box applications are commented. The *in-situ* determination of dyes or pharmaceuticals in waters is possible with small platforms [1]. The combination with bioreceptors allows integrating selectivity, especially in enzymatic and immunoelectrochemical assays. In this case, the electrochemical cell is the basis for the design of vertical flow assay platforms for clinical applications (*e.g.*, differential diagnosis of stroke), favored by non-invasive sampling. Electrochemical detection fits well with other types of bioassays such as the amplification of genetic material, extending the analysis to other relevant biomarkers. Isothermal amplification of specific sequences (*e.g.* of *Streptococcus pneumoniae* or SARS-CoV-2) using LAMP procedures has been combined with innovative detection methodologies, including the use of electrocatalytic Pd nanoclusters [2]. LAMP procedures and electrochemical readout can be integrated into a single device to avoid carryout contamination [3].

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References

[1] M. Cerrato-Alvarez, P. Rioboó-Legaspi, E. Costa-Rama, M.T. Fernández-Abedul, Biosens. Bielectron. **2025**, *267*, 116851.
[2] A. Rodríguez-Penedo, P. Rioboó-Legaspi, A. González-López et al., Adv. Healthc. Mater. **2023**, 2202972.
[3] P. Rioboó-Legaspi, E. Costa-Rama, M.T. Fernández-Abedul, Lab Chip **2024**, *24*, 4085.