

Arrays of voltammetric sensors using combinations of electrocatalytic materials for the analysis of foods

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Abstract

Electrochemical sensors have been prepared using a range of materials and using a variety of methods. The selection of phthalocyanines or nanoparticles as sensing materials in electrochemical sensors was inspired in their electrocatalytic properties¹. In turn, nanostructured sensors prepared using the Langmuir-Blodgett (LB) or the electrostatic Layer-by-Layer (LbL) techniques have the advantage of the enhanced number of active sites that has a reflect in the increase in the intensity. The control of molecular architectures afforded by these techniques can led to the development of a variety of devices where synergy is achieved by combining distinct materials, including organic-inorganic hybrids².

In this work combinations of phthalocyanines or conducting polymers with nanoparticles have been used as voltammetric sensors for the detection of compounds of interest in the food industry (i.e. phenols or organic acids). The role of the molecular interactions in the electrocatalytic properties has been studied and the existence of synergistic effects has been evidenced. For instance, the combination of phthalocyanines with gold nanoparticles in LB films produced an increase in the sensitivity towards phenols and detection limits of 10^{-7} mol.L⁻¹ were attained.

Biosensors have also been developed by introducing enzymes in the sensing layer. For instance LB films combining phthalocyanines and amphiphilic molecules provided biomimetic environments where enzymes could preserve their functionality. Detection limits as low as 10^{-8} mol.L⁻¹ towards phenols were attained.

Finally, the performance can be further improved by constructing arrays formed by sensors with complementary activity. The signals provided by the array analyzed by means of chemometric methods have allowed detecting antioxidants present in complex mixtures such as wines or musts.

¹ M.L. Rodríguez-Méndez, C. Medina, J.A. de Saja, C. Apetrei, R. Muñoz, *Sensor arrays based on phthalocyanines: New developments on nanostructured and biomimetic electrochemical sensors*. In Multisensor systems for chemical analysis: materials and sensors. Eds. L. Lvova, D. Kirsanov, C. Di Natale, and A. Legin. PAN STANFORD PUBLISHING. Chapter 4, 70-109 (2012)

² F. J. Pavinatto, E. G. R. Fernandez, P. Alessio J..C. Constantino, J. A. de Saja, V. Zucolotto'd O. N. Oliveira Jr. C. Apetrei, M. L. Rodriguez-Mendez, *Optimized architecture for Tyrosinase-containing Langmuir-Blodgett films to detect pyrogallol*, J. Materials Chemistry 21, 4995-5003 2011