Evaluation of different electrochemical sensors for heavy metals detection and removal

Mayla Metitiero[1,2]
Qiuyue Yang[1], Giulio Rosati[1], Massimo Urban[1], Stefano Cinti[2], and Arben Merkoçi[1,3]
[1]*Institut Català de Nanociència i Nanotecnologia (ICN2), Campus de la Universitat Autònoma de Barcelona, Edifici ICN2, Av. de Serragalliners, 08193 Bellaterra, Barcelona*
[2]*Department of Pharmacy, University of Naples "Federico II", Naples 80131, Italy*
[3]*Catalan Institution for Research and Advanced Studies (ICREA), 08010, Barcelona, Spain*
arben.merkoci@icn2.cat

Heavy metals (lead, cadmium, mercury, arsenic, copper, etc.), which pose the risk to the environment and the human body, are ubiquitous in natural waters due to their high solubility and can accumulate in different matrices, causing issues with respect to their removal. Their accumulation in human body may cause potent toxicity such as irritation, acute or chronic intoxication, carcinogenicity, etc. For example, copper and its compounds are also well-known to be used in agriculture as fertilizer and pesticide, but its accumulation can cause problems in the environment, and diseases in humans such as the Wilson disease. The detection of heavy metals, combined with new low-cost and green approaches to remove them from different matrices, is a very important topic. Although standard methods such as atomic absorption spectroscopy (AAS) and inductively coupled plasma mass spectrometry (ICP-MS) offer accurate detection, the requirement of time-consuming procedures, skilled personnel and expensive equipment often limit on-site application. As such, portable and user-friendly devices, which can operate on-site intervention are highly demanded, and electrochemical methods have been widely used for sensing heavy metals to fulfill this need. Two commonly used platforms of metallic sensing electrodes are: 1) bismuth-electrodes for sensing cadmium and lead and 2) gold-electrodes for sensing copper and arsenic; both are chosen for their high conductivity and limited toxicity. The electrochemical techniques used for heavy metals detection is the anodic stripping voltammetry (ASV) including linear sweep voltammetry (LSV), differential pulse voltammetry (DPV), and square wave voltammetry (SWV). Particularly, screen-printed electrodes are harnessed to operate the electrochemical detection. Herein, we will evaluate three different screen-printed heavy metal sensors in the literature [1-3] and compare the influence on their sensing performance from two aspects: the different substrates with different levels of porosity (i.e., plastic and paper), the sensing nanomaterials and the simplicity of their application for non-specialized users.

References

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