New amperometric biosensor for determination of heavy metal ions based on the enzymatic inhibition of HRP immobilized on ferrocenyl polycyclosiloxane/Gold Nanoparticles modified electrode

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Heavy metals such as lead, copper, cadmium and mercury are non-degradable, cannot be detoxified biologically and can accumulate in the biosphere and transfer to the alimentary chain, thereby giving arise to potential serious health consequences for human beings, animals and plants [1]. We focuse on lead and cooper ions because they may reach the environment due to conscious or unconscious human activities. Lead common sources are the PVC pipes in sanitation, recycled PVC lead paints, etc. as well as the lead batteries, while the common sources of cooper are the fertilizers, tanning, and photovoltaic cells [2]. Both ions are related with adverse effects on the human metabolic process [3,4]. In the last years, the enzyme inhibition caused by heavy metals has provided a new way to develop inhibition-based biosensors [5]. For this purpose, horseradish peroxidase (HRP) is one of more used enzymes due to their low cost, availability and easy immobilization. In addition, the incorporation of AuNPs in biosensing devices has found to improve the electrode surface and the electronic conductivity, since the AuNPs enhance the transfer of the electrons generated by the enzyme-catalyzed redox reaction to the electrode surface [6]. Furthermore, the AuNPs present a high biocompatibility with the enzyme Horseradish peroxidase (HRP) maintaining their bioactivity [7]. Based on our previous experience, here we present the first results obtained with an amperometric hydrogen peroxide (H_2O_2) biosensor developed by covalent immobilizing of HRP onto AuNPs electrodeposited from a ferrocenyl polycyclosiloxane, also electrodeposited film on a Pt electrode [8]. The biosensor show direct electrochemistry with the HRP and now is being successfully applied to the indirect determination of Pb^{2+} and Cu^{2+} based on the inhibition of the enzyme, with linear ranges of 0.05-0.7 mgL^{-1} and 0.05-1.20 mgL^{-1}, respectively, and a K_I 1.7 mgL^{-1} for the non-competitive inhibition of Pb. the rest of the study is being completed and its results will be displayed on the poster presented at the conference.

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FIGURES

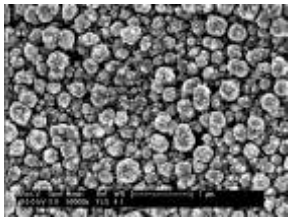

Figure 1: SEM image of the electrode surface previous to enzyme immobilization