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Highly Specific DNA-Aptamer-Based Electrochemical Biosensor for Mercury (II) and Lead (II) Ions Detection in Water Samples

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Abstract : Aptamers are single-strand of DNA or RNA nucleotides sequence which is designed in vitro using selection process known as SELEX (systematic evolution of ligands by exponential enrichment) were developed for the selective detection of many toxic materials. In this work, we have developed an electrochemical biosensor for highly selective and sensitive detection of Hg2+ and Pb2+ using a specific aptamer probe (SAP) labelled with ferrocene (or methylene blue) in (5′) end and the thiol group at its (3′) termini, respectively. The SAP has a specific coil structure that matching with G-G for Pb2+ and T-T for Hg2+ interaction binding nucleotides ions, respectively. Aptamers were immobilized onto surface of screen-printed gold electrodes via SH groups; then the cyclic voltammograms were recorded in binding buffer with the addition of the above metal salts in different concentrations. The resulted values of anode current increase upon binding heavy metal ions to aptamers and analyte due to the presence of electrochemically active probe, i.e. ferrocene or methylene blue group. The correlation between the anodic current values and the concentrations of Hg2+ and Pb2+ ions has been established in this work. To the best of our knowledge, this is the first example of using a specific DNA aptamers for electrochemical detection of heavy metals. Each increase in concentration of 0.1 μM results in an increase in the anode current value by simple DC electrochemical test i.e (Cyclic Voltammetry), thus providing an easy way of determining Hg2+ and Pb2+concentration.

Keywords : aptamer, based, biosensor, DNA, electrochemical, highly, specific
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