Ultrasensitive DNAzyme-based electrochemical biosensor for Pb²⁺ based on FcHT-mediated biocatalytic amplification

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A ultrasensitive DNAzyme-based electrochemical biosensor for Pb²⁺ was developed by simultaneously modifying with GR-5 DNAzyme-substrate complex and 6-(ferroceney) hexanethiol (FcHT, a electron mediator) on Au electrode. Horseradish peroxide (HRP) was employed as an electrochemical label. The ultrasensitive detection was achieved by the FcHT-mediated biocatalytic cycle between HRP and hydrogen peroxide (H₂O₂). The electrochemical biosensor was characterized using X-ray photoelectron spectroscopy (XPS) and electrochemical impedance spectroscopy (EIS). Cyclic voltammetry was used to monitor the increased electrocatalyzed reduction of H₂O₂ by HRP. The linear range and the detection limit were determined to be 0.1 nM to 1 μM and 0.03 nM (S/N=3), respectively. The validity of the proposed biosensor was tested in Pb²⁺-spiked water samples, and the results agreed well with those obtained by the conventional ICP-MS method.

Keywords: Electrochemical biosensor; Pb²⁺; DNAzyme; 6-(ferroceney) hexanethiol (FcHT), signal amplification

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