

Complexing of heavy metals with DNA and new bioaffinity method of their determination based on amperometric DNA-based biosensor

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Abstract

The immobilized single-stranded DNA (ssDNA) has been found to be a very effective biospecific analytical reagent when used in a newly developed bioaffinity method of the determination of heavy metals based on the amperometric DNA-based biosensor. This has been concluded from the comparative study of the complexing of heavy metals with double-stranded DNA, single-stranded DNA, and ssDNA, using Fe(III) and Cu(II) as a model (metal/nucleotide ratio and stability constants are maximum for ssDNA), from the study of adsorption of Fe(III), Cu(II), Pb(II), and Cd(II) on nitrocellulose membranes, containing single-stranded DNA, and from the determination of their binding constants with ssDNA. According to these data, the chosen heavy metals can be lined up in a series of binding strengths with ssDNA: Cu(II) > Pb(II) > Fe(III) > Cd(II). The method of the determination of heavy metals is based on biospecific preconcentration of metal ions on the biosensor followed by the destruction of DNA-metal complexes with ethylenediaminetetraacetate and voltammogram recording has been proposed. The lower detection limits are 4.0×10^{-11} , 1.0×10^{-10} , 1.0×10^{-9} , and 5.0×10^{-9} M for Cu(II), Pb(II), Cd(II), and Fe(III), respectively. The heavy metals have been assayed in multicomponent environmental and biological systems such as natural and drinking water, milk, and blood serum samples. © 2005 American Chemical Society.

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