Abstract

The interaction between three selected representatives of environmental pollutants – naphthalene, anthracene, and 2-aminoanthracene – and DNA was investigated using an electrochemical DNA biosensor based on a glassy carbon electrode (GCE) and low molecular weight DNA from salmon sperm (DNA/GCE). The interactions with DNA were monitored using square wave voltammetry (SWV) and electrochemical impedance spectroscopy (EIS). For naphthalene, there was no DNA damaging interaction observed. In the case of anthracene, the formation of an intercalation complex [DNA–anthracene] was observed. However, its formation does not cause DNA strand breaks. The formation of similar intercalation complex was observed for 2-aminoanthracene [DNA–2-aminoanthracene], where we suppose on the basis of the results obtained that the intercalation of 2-aminoanthracene into the DNA double helix induces a tension and subsequent formation of single-strand breaks, which cause that the fragments of DNA fall away from the electrode surface.

The intercalative interaction of DNA with anthracene a 2-aminoanthracene was used in the development of electrochemical methods for determination of these compounds at the GCE and DNA/GCE. At the development of the methods, DC voltammetry (DCV) and differential pulse voltammetry (DPV) were used. For the determination of anthracene, the DPV method was developed in a medium of ethanol/Britton-Robinson (BR) buffer of pH 5.0 (1:1). The limit of quantification (L_Q) at the GCE was 2.2 μmol/L. Using the DNA/GCE, the sensitivity of this method was increased and its L_Q was decreased to 0.15 μmol/L. The optimal medium for the determination of 2-aminoanthracene was ethanol/BR buffer of pH 7.0 (1:9). The L_Qs for the DPV determination of 2-aminoanthracene were 0.30 and 0.28 μmol/L at the GCE and GCE/DNA, respectively. The applicability of the newly developed methods for the determination of anthracene and 2-aminoanthracene at the DNA/GCE was successfully verified on model samples of gravel and sand.