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Development of a new biosensor by adsorption of creatinine deiminase on monolayers of micro- and nanoscale zeolites

S.V. Marchenko[1], B.O. Kasap[2], O.O. Soldatkin[1], B. Akata[2,3], A.P. Soldatkin[1], S.V. Dzyadevych[1]

[1] *Institute of Molecular Biology and Genetics, Natl.Acad. of Sci. of Ukraine, Zabolotnogo str., 150, Kiev-03143, Ukraine.*
E-mail: svmarchenkosv@ukr.net

[2] *Micro and Nanotechnology Department, Middle East Technical University, Ankara, 06531, Turkey.*

[3] *Central Laboratory, Middle East Technical University, Ankara, 06531, Turkey.*

Creatinine deiminase (CD) is an enzyme of the class of hydrolases, which converts creatinine to N-methylhydantoin and ammonium. To date, CD is widely applied for quantification of creatinine in real biological samples. Specifically, CD is a part of the reagents for biochemical analyzers; it is also used as a biosensitive element in different types of electrochemical biosensors. A lot of immobilization methods were used for the development of CD-based biosensors, but all of them have inherent shortages, such as toxicity of immobilizing agents, lack of sensitivity of a bioselective element and etc. Adsorption is known to be one of the most tolerant immobilization techniques, and zeolites - one of the best adsorbents.

In the work, we used such zeolites as silicalite, zeolite beta (BEA), zeolite nanoBEA, BEA modified with particles of gold (BEA-gold), and BEA modified with gold in ionic form (BEA-Au^{3+}). Using zeolites, the surfaces of pH-sensitive field-effect transistors (pH-FET) were modified and the monolayers with adsorbed CD were formed. For comparison, the method of CD immobilization in saturated glutaraldehyde vapor (GA) was used. It was shown that usage of the method of adsorption for CD immobilization on the surfaces of pH-FET modified with zeolite monolayers resulted in a decrease of the total response time and an increase of the sensitivity. Additionally, the measurement error diminished at the immobilization from one biosensor to another and the minimum detection limit reduced.

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