ABSTRACT

Charles University in Prague, Faculty of Pharmacy in Hradec Králové

Department of Analytical Chemistry

Candidate: Tereza Štipková

Supervisor: Assoc. Prof. PharmDr. Lucie Nováková, Ph.D.

Supervisor specialist: Assist. Prof. Gulnara Safina, Ph.D.

Title of thesis: Working performance of vertically aligned carbon nanotubes as platforms for future biosensing applications

Blood glucose monitoring is a crucial part of a modern diabetes therapy. In this work, the multi-walled vertically aligned on-chip grown carbon nanotubes (CNT) were applied in construction of a novel third-generation biosensor. The main focus of this work was to investigate the possibility of future application of the sensor in glucose monitoring. The CNT-based amperometric biosensor was developed by immobilising cellobiose dehydrogenase from *Corynascus thermophilus* onto the CNT surface by physical adsorption. The highly hydrophobic surface of the nanotubes was functionalized with 0.0001% (w/v) polyvinyl alcohol (PVA) in order to enable the enzyme adsorption. X-ray photoelectron spectroscopy measurements confirmed the successful enzyme immobilization onto PVA modified CNT surface. The surface topography and elemental composition of the nanomaterial were examined by scanning electron microscopy and energy-dispersive X-ray spectroscopy respectively. The optimal working conditions for flow-injection electrochemical measurements were found as follows: flow-rate of 0.5 ml/min and working potential applied of 0.3 mV. Under these conditions, the biosensor had a linear range between 1 - 25 mM glucose with the limit of detection of 1 mM. The range covers all concentrations likely to be found in human blood samples. Hence the sensor is eligible for the intended future application. A good operational stability of the sensor was observed when tested in flow-injection mode for the duration of 6 hours with relatively high concentration of glucose (10 mM) injected in 5 minute intervals. The maximum observed variation of current was 17.7 % and, by the end of the measurement, the sensor kept 100 % of its initial response.

Keywords: amperometric sensor, carbon nanotubes, cellobiose dehydrogenase, glucose