Magnetron sputtered polycrystalline cerium oxide thin film as a new material for H_2O_2 detection

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Hydrogen peroxide (H_2O_2) has significant importance in key processes in medicine, biology, the food industry, and can be a source of hazardous free radicals which are the reason for oxidative stress in living cells [1]. Therefore, it is necessary to develop reliable and sensitive methods and materials for H_2O_2 detection in different biological environments. Electrochemistry is one of the most promising techniques for this purpose due to its simplicity, short time response and good sensitivity. Nanomaterials, such as cerium oxide (CeO_2) are well known to exhibit specific enzyme-like activities that can be used for H_2O_2 detection [2].

In the current work, we propose polycrystalline cerium oxide thin films deposited on glassy carbon substrates as a new enzyme-free electrode for hydrogen peroxide detection. CeO_2 films were prepared by means of RF magnetron sputtering from a cerium oxide target in an argon atmosphere with total thickness of the film about 20 nm. The electrode detected H_2O_2 in the micromolar range in phosphate buffer solution (pH = 6.9), even without using a mediator. Electrochemical measurements show a current plateau, that represent the maximum rate achieved by the system, at saturated H_2O_2 concentrations, which is typical behaviour for enzymes. Stability in different pH was examined. Surface characterization performed by scanning electron microscopy (SEM) and atomic force microscopy (AFM), before and after the electrochemical measurements, demonstrate no significant changes of the electrode surface. The stability of the system was also investigated by highly surface sensitive synchrotron radiation photoelectron spectroscopy (SRPES).

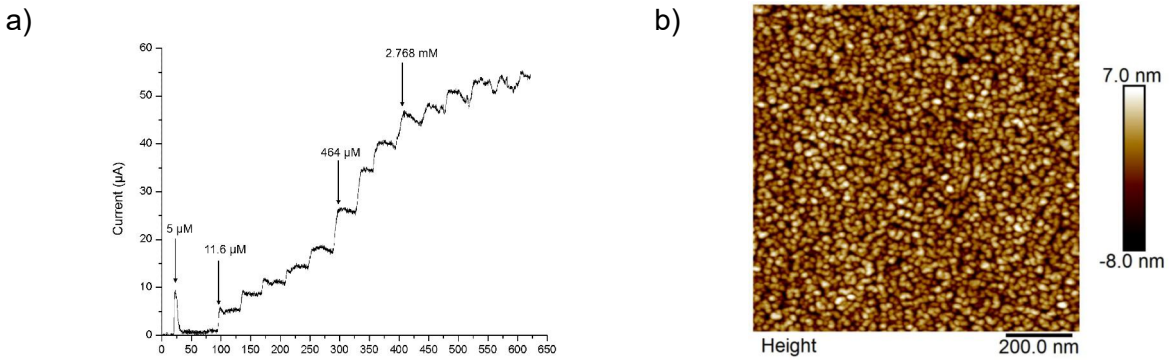

Figure 1. a) response of the CeO_2 electrode at 0.65 V to the additions of the H_2O_2 in phosphate buffer solution; b) AFM image of CeO_2 on glassy carbon substrate.

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