Electrocatalytical chemical sensor for hydrogen peroxide.

ABSTRACT

The fast and selective determination of hydrogen peroxide (H_2O_2) is of importance not only because of strong interest to this widely applied analyte but also because of the development of enzymatic biosensors for glucose or other metabolites where the sensor for H_2O_2 can be used as the transducer.

We report here electrocatalytical amperometric sensor for detection of H_2O_2. The sensor consists of a gold electrode covered by self-assembled monolayer (SAM) with immobilized *p*-benzoquinone. To provide highly stable immobilization of *p*-benzoquinone at the distance of effective electron tunneling, a new anchor compound - 1,3-dimercaptopropan-2-ol – was synthesized and used for the preparation of the SAM. Due to two thiol groups binding gold surface this compound provides a high stability of the SAM. The surface concentration of *p*-benzoquinone obtained from cyclic voltammetry is $2.5 \pm 0.2 \times 10^{-10}$ mol.cm^{-2}.

Cyclic voltammetry and chronoamperometry experiments proved that the immobilized benzoquinone exhibited high electrocatalytic activity towards the decomposition of H_2O_2. Depending on the used potential range, different sensing modes can be realized. For example, one can measure electrochemical response due to the oxidation of H_2O_2 at anodic potentials or due to the reduction of oxygen formed during oxidative decomposition of H_2O_2. Also amperometric response at fixed potential of +0.4 V vs. Ag/AgCl corresponding to the oxidation of benzoquinone to hydroquinone was studied. The sensor exhibited a linear response over a concentration range of 0.1-2 mM with a low detection limit of 4.24 μM. The reproducibility of three different electrodes prepared was examined at the H_2O_2 concentration range from 0.1 till 3 mM, which resulted in a relative standard deviation below 4.2%.