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Improving the current density and the coulombic efficiency by a cascade reaction of glucose oxidizing enzymes

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Abstract

Improvements in current density and coulombic efficiency of a glucose oxidizing electrode were realized by a combination of pyranose dehydrogenase from *Agaricus meleagris* (*Am*PDH) with glucose dehydrogenase from *Glomerella cingulata* (*Gc*GDH). The mixed enzyme electrode oxidizes glucose in several combinations at the C-1, C-2 and C-3 positions of the pyranose ring. This concerted action of enzymes increases (i) the coulombic efficiency by extracting more than 2 e^- per substrate molecule and (ii) the current density of the electrode when the mass-transfer of substrates becomes rate limiting. The electrodes were investigated with flow injection analysis (FIA) using different substrates under physiological conditions (pH 7.4). These investigations showed that the product of one enzyme can be used as substrate for the other enzyme and maximally 6 e^- can be gained from the oxidation of one glucose molecule using mixed enzyme electrode like *Am*PDH/*Gc*GDH/Os-polymer. We propose a bioanode for use in biofuel cells with an increased current density and coulombic efficiency obtained by a cascade reaction catalyzed by redox enzymes with a different site-specificity for glucose.

Key words: Bioanode, coulombic efficiency, cascade reaction, glucose dehydrogenase, Os-polymer, pyranose dehydrogenase