Using of polypyrrole-modified graphite electrode as biofuel cell anode

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Microbial fuel cells (MFC) can be used to purify water, generate electricity or be applied as a biosensor, however, due to their low current density, practical application is very limited. In this research, we present improved Bakers' yeast (S. cerevisiae) containing MFC modified with polypyrrole (Ppy) in presence of 9,10-phenanthrenequinone (PQ).

PQ acts as a redox mediator transferring electrons through the yeast membrane, thus resulting in greater membrane charge permeability, while only slightly halting the growth of yeast.[1] For further improvement of MFC, yeast cells were modified with a conductive polymer Ppy, synthesized by taking advantage of yeasts' own metabolism reactions. Ppy enhances electrical charge transfer from the microorganism to the electrode and in addition does not harm the yeast cell.[2]

Three PQ covered graphite electrodes, unmodified, covered with yeast and covered with Ppy-modified yeast were evaluated, each in two different solutions: in a blank PBS solution and in a glucose/ potassium hexacyanoferrate solution after 20 min of incubation. The performance of electrodes was evaluated by cyclic voltammetry: in glucose/potassium hexacyanoferrate solution unmodified electrode exhibited oxidative peak of 165mA, yeast-covered electrode had a substantially higher oxidative peak of 304mA, 1.84 times more than unmodified electrode, while the modified-yeast-covered electrode had the greatest oxidative peak of 369mA – 2.24 times more than unmodified electrode. From this we can conclude, that covering a graphite electrode with PQ and Ppy modified yeast increases its effectiveness by 2.24 times yielding higher values of potassium hexacyanoferrate oxidative peak currents, in comparison to results in covering the electrode with PQ only.

Keywords:
Saccharomyces cerevisiae; graphite electrodes; biofuel cells; 9,10-phenanthrenequinone; polypyrrole; cyclic voltammetry.

References:
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