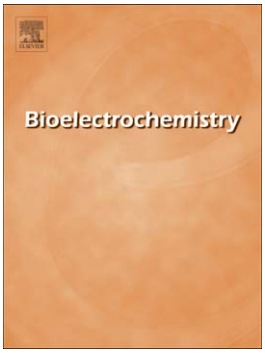

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Masahiro Kaneko, Masahito Ishikawa, Kazuhito Hashimoto, Shuji Nakanishi

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Molecular Design of Cytocompatible Amphiphilic Redox-active Polymers for Efficient Extracellular Electron Transfer

Masahiro Kaneko,[‡a] Masahito Ishikawa,[‡b] Kazuhito Hashimoto*[a] and Shuji Nakanishi*[c]

[a] Department of Applied Chemistry, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan.
E-mail: hashimoto@light.t.u-tokyo.ac.jp
[b] Research Center for Advanced Science and Technology, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8904, Japan.
[c] Research Center for Solar Energy Chemistry, Osaka University ,1-3, Machikaneyama, Toyonaka, Osaka 560-8531, Japan
E-mail: nakanishi@chem.es.osaka-u.ac.jp
‡ Both authors equally contributed to this work.

Abstract

For electrochemical regulations of the intracellular metabolisms, lipophilic electron mediators with cell membrane permeability have been conventionally used. We have recently developed amphiphilic, cell-membrane permeable polymer composed of hydrophilic 2-methacryloyloxyethyl phosphorylcholine and hydrophobic redox-active units as a new category of electron mediator. The advantage of the redox active polymer is that we can obtain appropriate molecules in a synthetic bottom-up manner. Here we report that the rate of the extracellular electron transfer (EET) through the redox active polymer can be regulated by sophisticated molecular design of the polymers. It was also shown that the cellular metabolism of yeast *Saccharomyces cerevisiae* was regulated by using the polymer with the highest EET rate.

Keywords

extracellular electron transfer, electron mediator, polymer, metabolism

1. Introduction

Cellular metabolism consists of numerous biological redox reactions. It is widely known that the intracellular redox state in living cells has a critical role for their metabolism [1–6]. For example, high mitochondrial NADH/NAD^+ ratio in yeast cells is known to trigger ethanol production [7]. Moreover, it was suggested that the intracellular NADH/NAD^+ ratio increases with aging, which could cause age-related metabolic diseases [8]. Thus, the development of techniques for regulating the intracellular redox state are demanded in various fields such as bio-energy and medical treatments. As redox reactions can be controlled by altering the electrochemical conditions, a number of studies have examined the electrochemical regulation of cellular metabolism using lipophilic electron mediators with cell membrane permeability