Photocurrent responses from reconstituted photosystem1 with molecular conductive wire adsorbed on the gold electrode.

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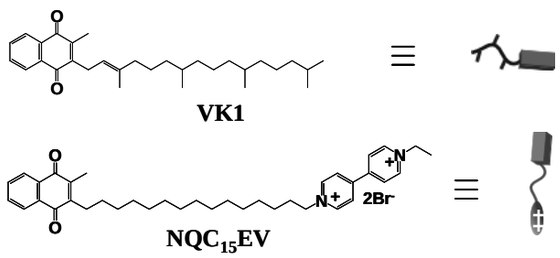
Bio-components from living body are very attractive materials, because they have already achieved ultra-high and ultimate performance with the cycle of natural selection and mutation. For example, It is well known that quantum yield of electron transfer in the photosynthesis reaction center is almost unit. Their high performances are due to well-designed spatial configuration (position, direction, and so on) and environmental control of functional molecules in the bio-component. Thus, in order to employ bio-components as core parts for artificial system, in other words, to transfer a signal between them and our system, it is very promising way to use a connector, which is designed in the molecular order.

In these viewpoints, we have designed the molecular conductive wire as the connector, and tried connect to the electron relay system in photosynthetic protein via reconstitution. In this study, we will discuss about the modification of photosynthetic protein on gold electrode via the reconstitution and the resultant photocurrent responses properties.

Photosystem1 (PS1), isolated from *synechococcus elongatus*, was used as photosynthetic protein, because there are many reports about structural analysis[1], electron transfer reaction[2], extraction and reconstitution at the specific molecular site[3], Vitaminn K1 (VK1), and so on. As the molecular wire, a Naphthoquinone-viologen linked compound (donated as $NQC_{15}EV$) was designed and synthesized in our group. Points for the design are described below. At first, there is PS1 binding site, naphthoquinone in this case. Second point is about molecular chain length, which is same to VK1, for leading the end of the chain to the outer side of the PS1 protein. The last, there is electron acceptor, in this case viologen, with appropriate potential to lead electron to the outer side of the PS1 protein along the electron wire.



Formulae. VitaminK1 and molecular wire (**$NQC_{15}EV$**).

VK1 was extracted from native PS1 with erter. Reconstitution of PS1with molecular wire adsorbed on gold electrode was occurred along the scheme of Fig. 1. The amounts of molecular wire adsorbed on gold electrode are estimate from Cyclic Voltammetry (CV) and Differential Pals Voltammetry (DPV). The ability of molecular wire was evaluated from the results of photocurrent responses in the three electrodes mode[4].

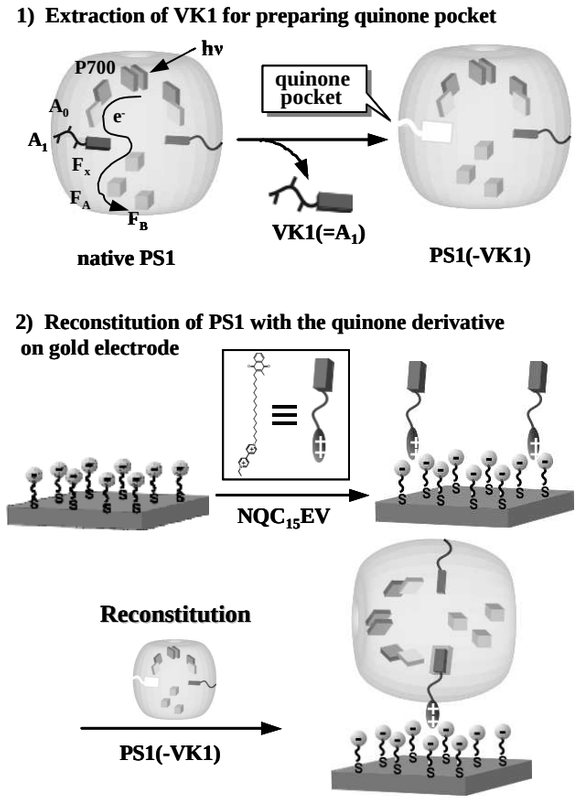


Figure 1. Schematic illustration of reconstitution with the molecular wire adsorbed on the gold electrode and PS1

The results of electrochemical measurement show that molecular wires were adsorbed on the gold electrode with low density. This was made by control the concentration of $NQC_{15}EV$ solution and immersion time at the adsorbed process, in order to prevent steric hindrance from neighborhood $NQC_{15}EV$.

With monochromic light irradiation, the photocurrent was measured to anodic direction under the present of Sodium Ascorbate. The peak position and shape of photocurrent action spectrum was almost overlapped on the absorption spectrum. This result clearly shows that the photocurrent responses were due to the photexcitation of PS1. The effects of molecular wire on the photocurrent responses will be discuss in the presentation.

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