# PHOTONIC ‘‘WIRING’’ OF ENZYMES WITH ELECTRODES FOR PHOTOBIOFUEL CELLS

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Despite the numerous studies on photochemically induced electron transfer in proteins [1], there is no precedence for the photonic wiring of redox enzymes with electrodes and their bioelectrocatalytic activation. The use of enzymes in fuel-generating solar cells has been discussed previously [2]. The electrical wiring of the enzymes in these systems was achieved, however, by applying natural cofactors (nicotinamide adenine dinucleotide (phosphate), NAD(P)þ) and their regeneration by photochemical means [3]. Also, the field of enzyme-based biofuel cells has been substantially advanced in the past decade, and numerous organic materials, such as alcohols, sugars, or a-hydroxy acids, have been used as fuels for the biocatalyzed generation of electrical power in the presence of oxygen ($O_2$) as oxidizer. The basic configuration of the biofuel cell element includes the circuiting of an electrically wired, enzyme-modified anode and cathode in the presence of the fuel and oxidizer. The design of a photobiofuel cell, inwhich the anode consists of a photochemically wired enzyme electrode that yields, upon irradiation, a fuel product that provides the source for the dark generation of electrical power by the biofuel/fuel elements, could provide the missing element for energy conversion and utilization. Efforts to design photovoltaic cells that include biomolecules, particularly enzymes, have been reported [4], yet these systems do not include the photowiring of the enzyme and the photochemical activation of the enzyme bioelectrocatalytic functions. Herein, we demonstrate a novel approach to construct photobiofuel cells. We show the photonic electron-transfer wiring ofGOxwith the electrode (Figure 1). The photobiofuel cell utilizes a photonically wired bioanode that oxidizes glucose with the concomitant evolution of hydrogen fuel at the cathode. The generation of hydrogen by the photobiofuel cell is particularly interesting, as it might act as the fuel substrate for the reduction of various organic substrates, such as ketones or keto-acids, while generating electrical power in conventional dark biofuel cell systems [5].

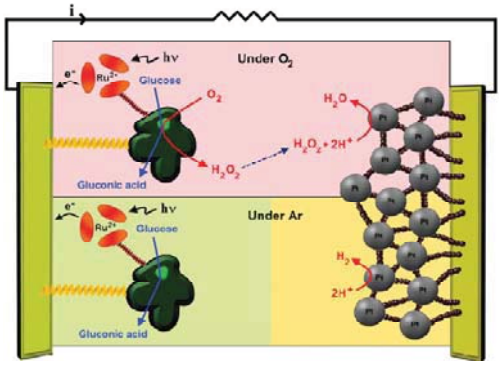


***Figure 1.*** *Mechanistic routes operating in the photobiofuel cell.*

**References**

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