Visible-Light Driven Regeneration of Nicotinamide Cofactor by Eosin Y-Sensitized Artificial Photosynthesis

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Mimicking natural photosynthesis is an attractive way to achieve a new form of renewable energy by using sunlight. For artificial photosynthesis, the photoinduced electron-transfer reaction should occur with a man-made light-harvesting antenna that can fulfil the role of both photosystems in natural photosynthesis. The efficient regeneration of nicotinamide or flavin cofactor is critical for the conversion of solar energy into fine chemicals because an oxidoreductase, working as a counterpart of the Calvin cycle, requires a stoichiometric amount of cofactors as redox equivalents. Therefore, in order to develop an artificial photosynthetic system, it is important to identify an efficient means of photoinduced electron transfer, especially in the visible-light range. Here, we found that eosin Y (EY) works efficiently as a molecular photoelectrode by catalyzing the visible-light-driven electron-transfer reaction for efficient regeneration of NADH through a photosensitizer–electron relay dyad. Injection of the photosensitized electron resulted in highly accelerated regeneration of NADH, which can be used by glutamate dehydrogenase for the photosynthesis of l-Glu.