Effects on the photochemical properties in proteorhodopsin by the mutation of the Glu108 residue


Proteorhodopsin (PR) is one of the microbial rhodopsins, which acts as a light-driven proton pump. It has been considered that Glu108 in PR (corresponding to Asp96 in bacteriorhodopsin) functions as an internal proton donor of the Schiff base during its cyclic photochemical reaction (called photocycle). On the other hand, the corresponding residue in a novel PR-like protein found in Exiguobacterium sibiricum (ESR) was a lysine, however, ESR had the proton pumping activity over a wide pH range and fast turnover photocycle. This indicates that the existence of a carboxylic residue in the cytoplasmic domain is not necessary for proton pumping. In this study, we investigated the effects of the mutation of Glu108 on the photocycle and accompanying proton transfer in PR.

Acetabularia rhodopsin II (ARII)のAsp81変異体による光誘起電流


ARII is a light-driven proton pump rhodopsin. Asp81 in ARI corresponding to Asp85 in bacteriorhodopsin is considered to function as a proton acceptor from the protonated Schiff base. We here determined how this proton acceptor coordinates with the protonated Schiff base and other amino acid residues to pump out a proton. The photo-induced current by D81S mutant exhibited transient; the light illumination induced the transient inward-current, whereas the turn-off of the light illumination induced the outward transient current. These transient currents remained unchanged irrespective of extracellular ions, Na+ and Cl-, implying that the transient currents might be due to an intracellular circulation of a certain ion.

Low-temperature FTIR spectroscopy of the Light-driven sodium ion pump: Krokinobacter eikastus rhodopsin 2


Krokinobacter eikastus rhodopsin 2 (KR2) is a newly discovered light-driven compatible sodium ion-proton pump1. KR2 pumps Na+ and Li+, while turning into proton pump in the presence of K+ or larger cations. The Na+ ion pumping activity has been shown to be completely suppressed at acidic pH and for D116N, the retinal Schiff base counterion mutant. To understand the mechanism behind this, we applied low-temperature light-induced difference FTIR2 and UV-vis spectroscopy at a range of pH for the wild type KR2 and the D116N mutant. We discuss the possible mechanisms of the light-driven Na+ ion pumping based on the analysis for these proteins and other mutants.


In situ 光照射固体 NMR による光受容体タンパク質センサ－ロドプシン I の光反応過程の解析


Salinibacter ruber Sensory rhodopsin I (S/SRI) is a photoreceptor membrane protein with a retinal chromophore, and has a dual function as positive and negative phototaxis. To characterize photo-intermediates in the photocycle of S/SRI, configuration change of [20-13C] retinal was distinctly observed by in situ photo irradiation solid state NMR [1]. During green and light irradiation, the retinal changed from all-trans to 13-cis, indicating that M-intermediate (attractant) was stationary trapped. M-intermediate changed to P-intermediate (repellent) with protonated Schiff base by illumination with UV-light. In conclusion, the dual function in S/SRI is induced by the color-discriminating isomerization of retinal. [1]Y. Makino et al.(2014) Angew. Chem. Int. Ed. in press