Structure and function of light-driven ion pumps in halophilic archaebacteria

Hiroaki Tomioka[1], Hiroyuki Sasabe[2], Masahiro Kamekura[3], Toshihisa Yoshida[1], Hideki Kandori[4], Yoshiko Shudo[5] and Sunichi Seki[6]
[1] Department of Chemistry, Faculty of Education, Saitama University
[2] The Institute of Physical and Chemical Research (RIKEN)
[3] Noda Institute for Scientific Research
[4] Department of Biophysics, Faculty of Science, Kyoto University
[5] Department of Electronic Engineering, University of Electro-Communications
[6] Department of physics, Science University of Tokyo

Photoreceptor protein, rhodopsin, olfactory receptor, hormone receptors and neurotransmitter receptors have a common structural motif, 7 transmembrane alfa-helices. Photon absorption and ligand bindings causes conformational changes in the receptors and the receptors take the excited states. Characterizations of the conformational changes and the actions of receptor proteins are required for revealing the structure-function relationship. Halobacterial rhodopsins which belong to the 7-helices family are stable proteins. The stability gives halobacterial rhodopsins advantages over other receptors in the various analyses. Four kinds of halobacterial rhodopsins have been found in the cell membranes. Two of them are light-driven ion pumps which convert the light energy into the chemical energy. The conformational changes of halobacterial rhodopsins are characterized by monitoring the color changes of the retinal chromophore.

Membrane vesicles of wild-type *Halobacterium* sp. mex strain show a wavy absorbance change which has not been so far reported in halophilic archaebacteria. A white mutant strain lacking carotenoids did not show the wavy absorbance change. The wavy absorbance change in the range of 440-590 nm was induced by a red flash (600-640 nm), which photoexcited electrogenic ion pumps, mex bacteriorhodopsin and mex halorhodopsin but not carotenoids. The wavy change was also caused by K^+ diffusion potentials without light. These results suggest that the wavy absorbance change in the membrane vesicles is the voltage-dependent absorbance change of the carotenoids. This absorbance change have potential in the precise evaluation of the membrane voltage. It may bring the great development in the undarstanding the mechanism of the ion pumping by proteins.