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Photoactivation of rhodopsins

Hideki Kandori

Nagoya Institute of Technology

Abstract

Rhodopsins are photoreceptive membrane proteins that bind retinal chromophore. In animals, rhodopsins work for vision, while microbial rhodopsins work for various functions such as light-driven ion-pumps, light-gated ion-channels, light sensors and light-activated enzymes. Optogenetics, which revolutionized brain sciences, started using channelrhodopsin as a tool.
Color tuning mechanism in our vision is a key question in the field, as we can discriminate various colors using three proteins (blue, green, and red absorbing rhodopsins) with a common chromophore, 11-cis retinal. There have been little structural studies, while our vibrational spectroscopy revealed unique structural features of our color visual rhodopsins.
Light causes specific retinal isomerization; 11-cis to all-trans in animal rhodopsins, and all-trans to 13-cis in microbial rhodopsins. An important aspect of photoisomerization in rhodopsins is that the shape-changing reaction occurs even at 77 K, where protein environment cannot move by freezing. Therefore, specific isomerization mechanism attracts many researchers.
In my talk, I will introduce recent topics of animal and microbial rhodopsins, including color tuning mechanism of our color-sensitive rhodopsins, and unusual photoisomerization pathway and temperature effect found in new microbial rhodopsins.