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Microbial rhodopsins: Rich functional diversity and great potential for optical control of biological activity

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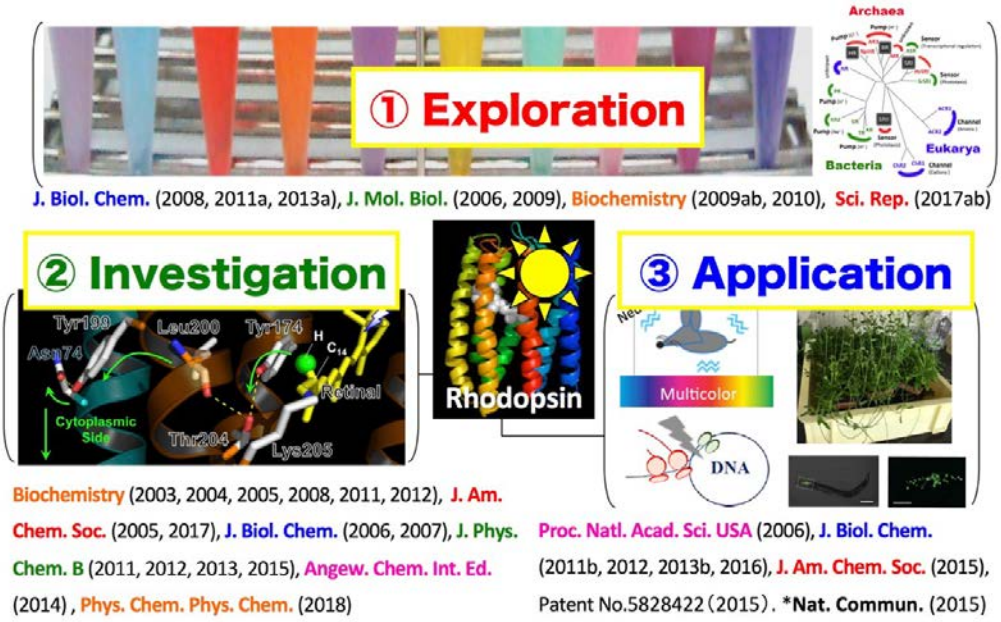
Rhodopsin is a member of the seven-transmembrane protein family that uses a retinal pigment (a derivative of vitamin-A) as a chromophore, which is covalently attached to the apoprotein opsin via a protonated Schiff base linkage with a perfectly conserved Lys residue. Visible light absorption of rhodopsin triggers *trans-cis* or *cis-trans* photoisomerization of the retinal chromophore and induces structural changes in the protein moiety, resulting in a variety of biological functions such as vision, ion transportation, and photosensing. Since 2000, genomic analyses have revealed a wide distribution of microbial rhodopsins in nature. In addition to their biological significance, when ion-transporting microbial rhodopsins are heterologously expressed in neurons, an action potential of neurons can be regulated upon light illumination. The technology is named as “optogenetics” and it enables the temporally and spatially precise control of neural activity by light.

Since 2000, I am focusing on exploration of novel microbial rhodopsins, investigation of their structural changes during the photoreaction and their application for controlling biological activity with light. Here I would like to introduce recent progress on our microbial rhodopsin research [1-7].



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