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Advanced light sensing natural proteins that can detect light intensity

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There are many photo-response biological proteins to convert the light energy to chemical energy, or to generate light information. It may be possible to use these proteins as advanced materials to detect light. For such applications, it is necessary to understand the molecular mechanism of the light detection of these proteins. In general, revealing conformation changes and intermolecular interactions is essential for the understanding. Although optical spectroscopies developed so far have been used for detecting dynamics of chemical reactions, there are many undetectable (spectrally silent) dynamics in biological reaction systems by these methods. It is desirable to develop a method to overcome this limitation. We have succeeded in detecting many intermediate species, which cannot be detected by traditional spectroscopic methods. The principle is based on the time-resolved detection of energies, volume changes, and the diffusion coefficient changes by the time-resolved transient grating (TG) method. Here I will demonstrate the method on a reaction of a blue-light sensor protein: PixD. We found a very unique light intensity dependence of the reaction, which may be used as an advanced material for the light sensor. PixD proteins are ones of photosensors containing the BLUF domain. They include Slr1694 (SyPixD) and Tll0078 (TePixD). SyPixD regulates phototaxis of cyanobacterium. Crystallographic analyses showed that these homologous PixD proteins have oligomeric structures: a decamer comprised of two stacked pentameric rings. We found that the dissociation reaction of the decamer is a key reaction for signal transduction and it will be used for application purpose. By using the TG technique, we discovered that the conformational change of the TePixD and SyPixDdecamer depend on the intensity of the excitation light. From the excitation light intensity dependence, we found that the multiphoton excitation of this protein is essential for the reaction.

Biography

Masahide Terazima has his expertise in physical chemistry for elucidating reaction mechanism. In particular, his current research interests are studies of chemical reaction dynamics of biological proteins. He has been developing new methods for direct detection of energy and conformation of reactive species in time-domain. Furthermore, he has succeeded in measurement of molecular diffusion processes in time-domain. He has discovered that the diffusion coefficient is sensitive to protein conformations, so that this technique can be used for tracing dynamical conformation change as well as intermolecular interaction changes.

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