

Time-resolved crystallography of light-driven ion transporters at synchrotrons and free electron lasers

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Microbial rhodopsins constitute a large superfamily of light-sensitive membrane proteins, which are vital for numerous microorganisms on Earth, and for 20 years also being most-actively used in neuroscience and medicine in the biotechnology named optogenetics. The major role for optogenetics is played by ion-transporting rhodopsins. Understanding of their molecular mechanisms of functioning can not only contribute to the fundamental biological knowledge of their roles in native host, but can enable their optimization towards routine use in medical application, such as restoration of eye vision and hearing. I will report on our recent advances in investigations of light-driven ion pumps, with particular focus on applying time-resolved serial crystallography at X-ray free electron lasers and synchrotrons to obtain molecular movies of the proteins in action. These include tracking of ultrafast changes and slower but more prominent rearrangements in a new type of sodium transporters, as well as in inward proton pumps. I will also discuss the optimization of sample delivery for more efficient time-resolved crystallography experiments and its implication for other systems, such as near-infrared-absorbing microbial rhodopsins.

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