World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:12, No:03, 2018

Excited State Structural Dynamics of Retinal Isomerization Revealed by a Femtosecond X-Ray Laser

Authors : Przemyslaw Nogly, Tobias Weinert, Daniel James, Sergio Carbajo, Dmitry Ozerov, Antonia Furrer, Dardan Gashi, Veniamin Borin, Petr Skopintsev, Kathrin Jaeger, Karol Nass, Petra Bath, Robert Bosman, Jason Koglin, Matthew Seaberg, Thomas Lane, Demet Kekilli, Steffen Brünle, Tomoyuki Tanaka, Wenting Wu, Christopher Milne, Thomas A. White, Anton Barty, Uwe Weierstall, Valerie Panneels, Eriko Nango, So Iwata, Mark Hunter, Igor Schapiro, Gebhard Schertler, Richard Neutze, Jörg Standfuss

Abstract : Ultrafast isomerization of retinal is the primary step in a range of photoresponsive biological functions including vision in humans and ion-transport across bacterial membranes. We studied the sub-picosecond structural dynamics of retinal isomerization in the light-driven proton pump bacteriorhodopsin using an X-ray laser. Twenty snapshots with near-atomic spatial and temporal resolution in the femtosecond regime show how the excited all-trans retinal samples conformational states within the protein binding pocket prior to passing through a highly-twisted geometry and emerging in the 13-cis conformation. The aspartic acid residues and functional water molecules in proximity of the retinal Schiff base respond collectively to formation and decay of the initial excited state and retinal isomerization. These observations reveal how the protein scaffold guides this remarkably efficient photochemical reaction.

Keywords : bacteriorhodopsin, free-electron laser, retinal isomerization mechanism, time-resolved crystallography
Conference Title : ICPPP 2018 : International Conference on Photobiology, Photochemistry and Photophysics
Conference Location : Rome, Italy
Conference Dates : March 05-06, 2018