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Dynamical Single Molecular Observations of Membrane Proteins Using X-rays

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Recently, we succeeded picometer-scale slow Brownian motions of individual protein membranes (Bacteriorhodopsin (BR) [1] and Potassium channel KcsA[2]) in aqueous solutions from time-resolved single molecular observations using X-rays. In this single molecular detection system with X-rays, which we call Diffracted X-ray Tracking (DXT) [3, 4], we observed the rotating motions of an individual nanocrystal, which is labeled to the specific site in individual protein molecules. In the case of BR, we observed Brownian motions and momentarily structural change of individual single BR in the light irradiation. We have consequently confirmed that the average size of the momentarily structural changes by light irradiation in 35th residue of BR was 76±48.2pm. In the case of Potassium channel KcsA, we observed the rotational motions of the central pore of KcsA in the open transition at low extracellular pH conditions. The size of the observed rotations occurs with about 20-30 degrees during 100-300ms. We measured both the full-length KcsA and the pore part of KcsA.

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