

## Time Resolved Measurements of Compressibility Reveal Driving Force of a Protein Reaction

Masahide Terazima<sup>C,S</sup>

*Department of Chemistry, Kyoto University, Kyoto, Japan*

*mterazima@kuchem.kyoto-u.ac.jp*

The thermodynamics have been playing very important roles in revealing the nature of molecules in solution. However, contrary to the well-developed time-resolved spectroscopy, thermodynamic properties during chemical reactions in solution in a time-resolved manner is still very difficult. Recently our group has been working on time-resolved thermodynamics for a variety of photochemical processes in nano - seconds time range. We used the pulsed laser induced transient grating (TG) for quantitative measurements in time domain. Here we will report on the thermodynamic studies of short lived intermediate species of a biological protein, TePixD. TePixD is a blue light sensor. The photochemistry of TePixD studied by absorption spectroscopy revealed that the spectrum of this protein changes after photo excitation within 100 ps. However, there is no absorption change after this ultrafast reaction. We used the TG technique to reveal the spectrally silent dynamics in nanosecond - second time range, which should be essentially important for the biological function. We succeeded in detecting two spectrally silent reaction phases after the creation of the first intermediate by detecting the volume change, enthalpy change, and the diffusion change, which represents the conformational change occurring far from the chromophore. Furthermore, for characterizing these intermediates, we measured the compressibility, and found that this property is enhanced during the reaction. The physical meaning of this enhancement will be discussed.