**Ultrafast molecular dynamics and response revealed by intense attosecond pulse trains**

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**Abstract**

The molecular dynamics caused by the irradiation of the ultrafast XUV pulse can serve a simple guideline to control the molecular system with a model of adiabatic potential surfaces of electronic states. This situation should be distinct from the molecular dynamics caused by the strong field of an infrared laser pulse, because the strong field is always accompanied by the distortion of potential surfaces. Therefore, we were aiming to study the nonlinear optics of XUV high-order harmonic (HH) fields of femtosecond laser pulse, which is equivalent to an attosecond pulse train (APT) in the time domain, such that we can realize the XUV-pump & XUV-probe experiments to resolve ultrafast motion in the femtosecond or even in the attosecond regime. Owing to the high intensity of an APT from the HH beamline developed in our laboratory, we have successfully carried out the XUV-pump & XUV-probe experiments to exhibit the attractive features of molecular systems. In this presentation, I will introduce two examples of such experiment. First, I will talk about the observation of real time motion of a vibrational wavepacket created in H2+ molecule with irradiation of the pump XUV APT to H2 molecule. By virtue of the vibrational motion of H2+ molecule and high photon energies of the XUV HH components, we were able to control the two distinct pathways of dissociation. Second topic is the two-photon ionization/dissociation of acetylene molecule. By adopting the yields of three kinds of fragment ions, CH+, C+, H+, as the indicators of autocorrelation measurement of an APT, the response time of ionization/dissociation processes in the attosecond regime will be discussed. These studies pave the way to the control of ultrafast molecular dynamics with more evolved technique using three XUV pulses as pump, control, & probe.