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2020

An, S., Kim, D., & Kim, S. K. (2020). Time-resolved experiment of IR-induced anion reaction dynamics. Proc. Of the 7th Asian Spectroscopy Conference (ASC 2020).
doi:10.32655/ASC_8-10_Dec2020.57

<https://hdl.handle.net/10356/144323>

https://doi.org/10.32655/ASC_8-10_Dec2020.57

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Time-resolved Experiment of IR-Induced Anion Reaction Dynamics

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Abstract

A pump-probe experiment with the picosecond laser system was designed to reveal the vibrational mode-effect on the anion reaction dynamics. Vibrational excitation by IR pulse initiates the reaction of anions, such as autodetachment, electron-transfer, and isomerization. Visible pulse after IR pulse can detach the electron from the reaction product. Reaction rate, yield, energy, and isomer distribution can be obtained from the kinetic energy distribution of detached electron. Anion source, mass selection system, VMI photoelectron spectrometer, and high-intensity mid-IR^[1] have been prepared for this IR-Vis pump-probe experiment.

To overcome the low density of the ion packet and low absorption cross-section for the IR, we constructed the high-intensity (50~100 uJ) mid-IR optical setup for the picosecond laser system. Using the nonlinear property of the KTA crystal, we obtained mid-IR pulse (3000 ~ 5000 nm) from the difference frequency mixing between 791 nm and near-IR (950 ~ 1050 nm) pulses. 791 nm laser pulse was obtained from the 1 kHz picosecond amplifiers seeded by the Ti:sapphire oscillator. Near-IR pulse was generated from the optical parametric amplifier system pumped by 791nm pulse

For the first target system, we planned the time-resolved photoelectron experiment for the nitromethane anion. Electrons can be autodetached by vibrational excitation^[2] and we will measure autodetachment rate with our picosecond laser system. By comparing the autodetachment rate for each vibrational mode, we will be able to reveal the mechanism and vibrational mode effect on the autodetachment dynamics of ground state anion.

Keywords: Anion reaction dynamics, Vibrational mode-effect, Mid-IR, Autodetachment

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