TERAHERTZ SPECTROSCOPY OF MOLECULES, RADICALS AND IONS USING EVENSON-TYPE TUNABLE FIR SPECTROMETER

FUSAKAZU MATSUSHIMA, *Department.of Physics, University of Toyama, Gofuku 3190, Toyama 930-8555, Japan*.

Frequencies of pure rotational transitions of neutral molecules, free radicals, and ionic molecules in the terahertz region have been measured precisely by using a frequency tunable far-infrared spectrometer in Toyama for more than 2 decades. The spectrometer (sometimes called as TuFIR in short) was developed by K.M. Evenson about 30 years ago [a] [b]. The terahertz light source is generated by synthesizing difference frequency of two mid-infrared CO_2 laser lines using a MIM diode as a photo mixer. A microwave radiation is added so that the tunable sidebands are obtained. The molecules and ions investigated up to now in Toyama are; 1) neutral molecules or radicals (LiH, KH, ^{18}OH, NH, $N^{18}O$, NH_3), 2) molecule with internal rotation (CH_3OH including transitions between different torsional states), 3) water molecules ($H_2{}^{16}O$ including v_2=1 excited state, $H_2{}^{17}O$, $H_2{}^{18}O$, D_2O), 4) molecular cation (protonated rare gas atoms such as HeH^+, NeH^+, ArH^+, KrH^+, XeH^+ including their isotopic species, H_2D^+, N_2H^+, H_2F^+), 5) molecular anion (OH^-, OD^-). The following topics are picked up in the talk. 1) principle and properties of TuFIR spectrometer with its history of developments, 2) some efforts to extend the properties of the spectrometer, 3) extended negative glow discharge cell: its property and recent application to investigate molecular ions.

[a] K.M. Evenson, D.A. Jennings, and F.R. Peterson, Appl. Phys. Lett. **44**, 576 (1984)
[b] I.G. Nolt et al., J. Mol. Spectrosc., **125**, 274 (1987)