

## FAR-INFRARED AND MICROWAVE SPECTROSCOPY OF HCOOCH<sub>3</sub>

KAORI KOBAYASHI, RYO OHYAMA, *Department of Physics, University of Toyama, Toyama, Japan*; NOBUKIMI OHASHI, *Kanazawa University, Kanazawa, Japan*; DENNIS W. TOKARYK, *Department of Physics, University of New Brunswick, Fredericton, NB, Canada*; BRANT E. BILLINGHURST, *EFD, Canadian Light Source Inc., Saskatoon, Saskatchewan, Canada*.

Methyl formate (HCOOCH<sub>3</sub>), is an important interstellar molecule, first detected about 40 years ago in a giant molecular gas cloud SGR B2. <sup>a</sup> More than 1000 rotational transitions including those of its isotopologues and in the torsional excited states have been observed from several astrophysical sources. The laboratory spectra of methyl formate (HCOOCH<sub>3</sub>) exhibit many unassigned transitions and many of them would be due to rotational transitions in the low-lying excited states. Previous astronomical identification of the torsional excited states indicates that rotational transitions in the more excited vibrational states can also be observed in astrophysical sources. In laboratory, two new series of transitions have been identified in the rotational data, and based on intensity, they lie about 300 cm<sup>-1</sup> and 450 cm<sup>-1</sup> above the ground state. <sup>b</sup>

There are many candidate vibrational excited states in this region and therefore, we decide to observe high-resolution far-infrared spectra to identify the responsible vibrational excited state and also to provide a feedback to the assignment of the microwave spectra.

The experiment was performed on the Far-Infrared Beamline of the Canadian Light Source synchrotron. Methyl formate at a pressure of about 2-8 mTorr was admitted into a 2-m-long White cell cooled to 198K. The cell was set to provide 36 transits of the far-infrared synchrotron radiation, for a total path length of 72 m. Spectra were obtained with both a Si:bolometer and Cu:Ge detector at full resolution (0.00096 cm<sup>-1</sup>). Very dense spectra of the C-O-C deformation and C-O torsional modes were obtained with high signal-to-noise ratio between 300-360 cm<sup>-1</sup>. More than 30000 transitions were observed and the detail of analysis will be reported.

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<sup>a</sup>R. D. Brown, J. G. Crofts, P. D. Godfrey, F. F. Gardner, B. J. Robinson, & J. B. Whiteoak, *Astrophys. J. Lett.* **197**, L29 (1975).

<sup>b</sup>Y. Sakai, K. Kobayashi, M. Tsukamoto, M. Fujitake, & N. Ohashi, *International Symposium on Molecular Spectroscopy, 67th meeting.* **RF05** (2012).