The microwave spectroscopy of *trans*-ethyl methyl ether

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1.Introduction

Trans-ethyl methyl ether ($CH_3CH_2OCH_3$) is the next simplest ether structure after dimethyl ether (CH_3OCH_3), and dimethyl ether has been observed in many spectra as an interstellar molecule. It was identified in Orion KL [1]. The rotational structure of this molecule is very much complicated because it has two internal rotors and there are many low-lying vibrational excited states. One rotational level splits into 5 sublevels (AA, AE, EA, EE1, and EE2). In a laboratory microwave study, Hayashi and Kuwada measured in the frequency range of 8.5 - 34 GHz, and gave molecular constants, dipole moment, and the molecular structure [2]. In addition, past study, K. Kobayashi and her collaborators analyzed this molecule in the first skeletal torsional excited state [3], $v_{29} = 1$ excited torsional state [4] and determined twenty-two molecular parameters composed of rotational constants, centrifugal distortion constants, internal rotation parameters and internal rotation tunneling parameters for the ground state, and three torsional states were also reanalyzed [5]. In this study, we extended and analyzed microwave spectra, providing effective molecular parameters of the AA sublevel in the ground state, and low-lying vibrational excited states.

2.Experiment

All the measurements were made using our conventional frequency modulation spectrometer in the frequency range of 330 - 360 GHz. The experiment was carried out at room temperature.

3.Results

The observed spectra were analyzed together with our previous 202 - 330 GHz data. Over 2500 transitions were newly assigned and analyzed over 6000 transitions in total. The highest J and K values of each vibrational states were 98, and 22 in the ground state, 98, and 19 in the skeletal torsional excited state, 99, and 16 in the C-CH_3 torsional excited state, and 98, and 17 in the O-CH_3 torsional excited state, respectively. We plan to further assign and analyze other sub-levels in the future.

References

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