DETECTION OF SiH_4–H_2O BY FOURIER TRANSFORM MICROWAVE SPECTROSCOPY

Y. KAWASHIMA, *Department of Applied Chemistry, Kanagawa Institute of Technology, Atsugi, Kanagawa 243-03, Japan*; R. D. SUENRAM, *Optical Technology Division, National Institute of Standards and Technology, Gaithersburg, MD 20899*; E. HIROTA, *The Graduate University of Advanced Studies, Hayama, Kanagawa 240-01, Japan*.

The microwave spectra of the normal species, ^{29}Si, ^{30}Si, ^{18}O, and ^{2}H SiH_4–H_2O have been measured using a pulsed-nozzle Fourier transform microwave (FTMW) spectrometer. Two, four and five strong transitions were observed for the $J = 1 \leftarrow 0$, $2 \leftarrow 1$, and $3 \leftarrow 2$ transitions, respectively in the 7 to 22 GHz region. Almost all of the observed lines consisted of two or three components. The spectral patterns observed for SiH_4–H_2O were different from those of CH_4–H_2O[a], CH_4–HCl[b], and Ar–SiH_4[c]. The observed line frequencies were fitted to the expression for the rotational spectrum of a linear molecule. The centrifugal distortion constant of the set appearing at lower frequencies than the K=0 transition is much smaller than those of other transitions. The rotational constants thus obtained, give an Si-O bond length of 3.38Å, which is much shorter than the C-O bond length in CH_4–H_2O (3.70Å). The value of the stretching force constant estimated for SiH_4–H_2O from the rotational and centrifugal distortion constants is larger than that for the C-O bond in CH_4–H_2O. We thus conclude that the Si-O bond in SiH_4–H_2O is much stronger than the C-O bond in CH_4–H_2O. From the observed Stark effect in SiH_4–H_2O, the electric dipole moment was determined to be 1.730 Debye. The structural and dipole data indicates that the water moiety is located with its C_2 axis coinciding with the van der Waals bond.

[a] R.D. Suenram, G.T. Fraser, F.J. Lovas, and Y. Kawashima, *J. Chem. Phys.*, **101**, 7230 (1994)
[b] Y. Ohshima and Y. Endo, *J. Chem. Phys.*, **93**, 6256 (1990)
[c] Y. Kawashima, R.D. Suenram, G.T. Fraser, F.J. Lovas, and Y. Hirota, 51st Symposium on Molecular Spectroscopy, (1996). TD08