The Pure Rotational Spectrum of Magnesium Sulfide Produced by Laser Ablation

Kaley A. Walker and Michael C. L. Gerry, *Department of Chemistry, University of British Columbia, Vancouver, B.C., Canada, V6T 1Z1.*

A new laser ablation system has been built that incorporates a Smalley-type ablation nozzle[a] into our existing pulsed molecular beam-microwave Fourier transform (MWFT) spectrometer. The second harmonic of a Nd:YAG laser is used to ablate a metal rod, which is located in the throat of a nozzle. The rod is rotated to provide a fresh surface for each laser pulse. This ablation setup has been mounted into one of the cavity mirrors, so that the molecular beam travels parallel to the direction of microwave propagation. This configuration results in linewidths of $\sim$ 10 kHz FWHM.

To test this new system, the microwave spectrum of MgS has been measured. The $J = 1 - 0$ transitions of 4 isotopomers, including the $^{25}Mg^{32}S$ isotopomer which exhibits nuclear hyperfine structure due to the ^{25}Mg nucleus, have been observed at 16 GHz. Improved rotational and centrifugal distortion constants have been obtained for the main isotopomer, $^{24}Mg^{32}S$, by fitting the $J = 1 - 0$ transition with data from a previous millimeter wave study[b]. From the isotopic data, the internuclear distance was calculated. The ^{25}Mg nuclear quadrupole coupling constant has also been determined. We believe this to be the first measurement of the microwave spectrum of a metal sulfide produced by laser ablation.

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[a] T. G. Dietz, M. A. Duncan, D. E. Powers and R. E. Smalley, J. Chem. Phys. **74**, 6511 (1981)

[b] S. Takano, S. Yamamoto and S. Saito, Chem. Phys. Lett. **159**, 563 (1989)