Rotational Raman Spectrum of Oxygen

Koichi ABE and Takehiko SHIMANOUCHI

Department of Chemistry, Faculty of Science, The University of Tokyo, Hongo, Bunkyo-ku, Tokyo

(Received August 14, 1969)

We have measured the Raman spectrum of oxygen at one atmospheric pressure, using a JEOL argon ion laser as the exciting source and a Nalumi Raman spectrometer. The monochromator is equipped with a 300 line/mm Bausch and Lomb 35—53—32—45 echelle grating. The focal length is 2m ($F=11$) and the twelfth order diffraction gives the linear dispersion of 2.4 cm^{-1}/mm at 5000A. Eastman Kodak 103-aF film was used and the exposure time was 5—24 hr. The Raman cell was placed in the laser cavity and the beam was focused at the Raman cell.

We have found that the lowest frequency Raman lines corresponding to the $N=1\rightarrow N=3$, $N=3\rightarrow N=5$ and $N=5\rightarrow N=7$ transitions have satellites on both sides of the main lines. The multiplicity is interpreted to be caused by the spin-spin coupling in the $^3\sum_g^-$ ground state of oxygen. The main line and the satellites are assigned to the $\Delta J=2$ and 0 and $\Delta J=1$, respectively, except for the $N=1\rightarrow N=3$ transition, where the case of $J=0\rightarrow J=2$ is included in the higher frequency satellite.

In the course of the study we were informed that Renschler, Hunt, McCubbin and Polo measured the same phenomena in the spectra excited in the cavity of the He-Ne laser (1). Since independent observation by the argon ion laser completely eliminates the possibility of ghosts, the result is reported here.

The microphotometer reproduction of the spectrum is shown in Fig. 1 with the assignments, confirming the interpretation given by Renschler *et al.*

We are grateful to Professor McCubbin for communicating the result before publication.

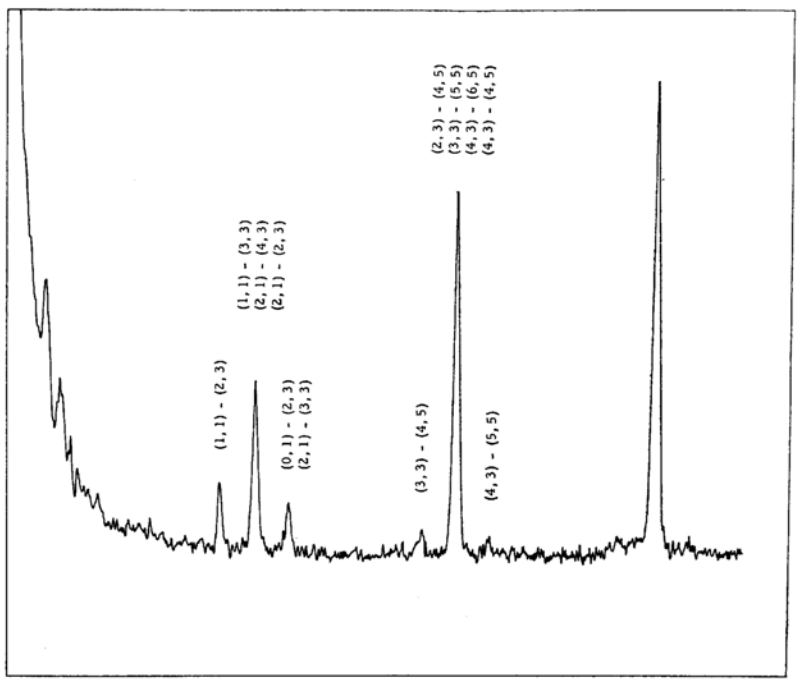

Fig. 1. Stokes lines with satellites. Assignments are shown as (J'', N'')-(J', N'). The Rayleigh line has the Stokes and Antistokes satellites corresponding to the $\Delta N=0$ and $\Delta J=1$ transition. However, it is accompanied also with ghost lines and the assignments are not definite.

1) D. L. Renschler, J. L. Hunt, T. K. McCubbin, Jr., and S. R. Polo, *J. Mol. Spectry.*, **31**, 173 (1969).