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Near-Infrared Absorptions of C_2 Radicals

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Doppler-limited near-infrared absorption spectrum of C_2 radicals has been recorded in acetylene/He plasmas generated by AC hollow-cathode discharges. Using a 2-m hollow cathode cell and a set of White-cell mirrors, an effective optical path of 48 m was attained by 24 traversals. With the concentration modulation technique to achieve zero-background detection, a sensitivity of ~2×10^{-7} in fractional absorption was realized. New rovibronic transitions of the $d^3\Pi_g \leftarrow c^3\Sigma_u^+$ system [1] and the $d^3\Pi_g \leftarrow a^3\Pi_u$ (Swan) system [2] of C_2 were observed, respectively, in spectral regions of 12000–12550 and 13750–14200 cm^{-1}. While the spectrum in both regions are highly congested with intricate pattern, the unprecedented resolution of the instruments allowed the spectrum to be fully resolved for analysis. For the $d^3\Pi_g \leftarrow c^3\Sigma_u^+$ system, the (1,0) and (2,1) vibronic bands were observed and analyzed to obtain accurate spectroscopic constants for the v = 0 and 1 levels of the $c^3\Sigma_u^+$ state [3]. The v = 1 level was confirmed to be perturbed as pointed out by Schmidt and coworkers [4]. While most constants are in excellent agreement with those reported in Ref. [4], discrepancies were found in a few constants. For the Swan system, the $\Delta v = -4$ sequence was observed for the first time [5]. Two vibronic bands, namely the (4,8) and (5,9) bands, were observed and analyzed. Molecular constants obtained from the least-squares fitting of the (5,9) band are consistent with those reported by Tanabashi *et al*. [2]. The (4,8) band, however, was found to be heavily perturbed that a least-squares fitting was not attempted. In this presentation, The experimental conditions, detailed analysis of the perturbations, and the determined molecular constants for both systems are reported.

References

[1] D. L. Kokkin, N. J. Reilly, C. W. Morris, M. Nakajima, S. H. Kable, and T. W. Schmidt, *J. Chem. Phys*. **125**, 231101 (2006).

[2] See, for a recent review, A. Tanabashi, T. Hirao, T. Amano, and P. F. Bernath, *Astrophys. J. Suppl. Ser*. **169**, 472 (2007).

[3] M.-C. Chan, S.-H. Yeung, N. Wang, and A. S.-C. Cheung, *J. Phys. Chem. A*, in press.

[4] J. A. Joester, M. Nakajima, N. J. Reilly, D. L. Kokkin, K. Nauta, S. H. Kable, T. W. Schmidt, *J. Chem. Phys*. **127**, 214303 (2007).

[5] S.-H. Yeung, M.-C. Chan, N. Wang, and A. S.-C. Cheung, *Chem. Phys. lett*. **557**, 31 (2013).