Laser Absorption Spectroscopy of $TiCl^+$: Analysis of the $[17.9]^3\Delta$-$X^3\Phi$(0,0) Band

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The laser absorption spectrum of the $TiCl^+$ molecular ion was observed for the first time in a hollow cathode discharge. The discharge was driven at 25 kHz at powers in the range of 80-100 W. Peak currents of 0.5 A occured during the conducting half-cycles. Flowing samples of $TiCl_4$ in Ar were discharged. 235 lines of the $^{48}Ti^{35}Cl^+$ $[17.9]^3\Delta$-$X^3\Phi$ (0,0) band and 122 lines of the $^{48}Ti^{37}Cl^+$ $[17.9]^3\Delta$-$X^3\Phi$ (0,0) band were recorded at resolution 0.02 cm^{-1}. This band system was observed previously [a] in the emission spectrum of $TiCl^+$ but the electronic assignments for the lower and upper states of the transition are revised here. Rotational constants (in cm^{-1}) and internuclear distances r_0 (in nm) for the $[17.9]^3\Delta$ (v=0) and $X^3\Phi$ (v=0) states of $^{48}Ti^{35}Cl^+$ and $^{48}Ti^{37}Cl^+$ are respectively:

$$B_0' = 0.178692(16),\ r_0' = 0.2160(1),\ B_0'' = 0.174212(16),\ r_0'' = 0.2188(1),$$
$$B_0' = 0.173076(18),\ r_0' = 0.2160(1),\ B_0'' = 0.168742(18),\ r_0'' = 0.2188(1).$$

These results are in excellent agreement with the predictions based on the ligand field theory models [b]. The symmetry for the ground state of the $TiCl^+$ molecular ion is determined to be $X^3\Phi$. Work supported by AFOSR under grant F19628-90-C-025.

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[a] W. J. Balfour and K. S. Chandrasekhar, J. Mol. Spectrosc. 139, 245-252 (1990).

[b] L. A. Kaledin, J. E. McCord, and M. C. Heaven, J. Mol. Spectrosc. 173, 499-509 (1995).