THE PURE ROTATIONAL SPECTRUM OF $SiCl^+$ ($X^1\Sigma^+$) AND SiCl ($X^2\Pi_r$)

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The pure rotational spectrum of $SiCl^+$ ($X^1\Sigma^+$) has been recorded using millimeter/submillimeter direct absorption methods. This work is the first measurement of the rotational spectrum for this species. The ion was created from $SiCl_4$ in the presence of argon carrier gas and an AC discharge. Data have been recorded from 103 to 463 GHz for the main isotopologue in its ground vibrational state. Additional transitions have been measured for the $^{28}Si^{37}Cl^+$, $^{29}Si^{35}Cl^+$, and $^{30}Si^{35}Cl^+$ isotopologues, and for $^{28}Si^{35}Cl^+$ in the v = 1, 2, and 3 states. The rotational spectrum of $^{28}Si^{35}Cl$ and $^{28}Si^{37}Cl$ in their $X^2\Pi_r$ state has also been measured using Fourier transform microwave (FTMW) techniques. The J = 2 $\rightarrow$ 1 and 3 $\rightarrow$ 2 transitions were recorded for both isotopologues in the range 22-38 GHz. The spectroscopic constants have been determined for both species using the appropriate Hamiltonian, including chlorine hyperfine parameters for SiCl. The bond length for the ion has been found to 0.115 Å shorter that for the neutral, indicating that the electron lost from SiCl to produce $SiCl^+$ comes from an anti-bonding orbital.