THE PURE ROTATIONAL SPECTRUM OF $TiCl^+$ ($X^3\Phi_r$) BY VELOCITY MODULATION SPECTROSCOPY

D. T. HALFEN and L. M. ZIURYS, *Department of Chemistry, Department of Astronomy, and Steward Observatory, University of Arizona, Tucson, AZ, 85721.*

The pure rotational spectrum of the molecular ion $TiCl^+$ ($X^3\Phi_r$) has been measured using millimeter-wave direct absorption methods incorporating velocity modulation techniques. This species is the first metal-containing molecular ion observed with millimeter-wave velocity modulation spectroscopy. $TiCl^+$ was created in an AC glow discharge of gas-phase $TiCl_4$ and argon. Ten, eleven, and nine rotational transitions of $^{48}Ti^{35}Cl^+$, $^{48}Ti^{37}Cl^+$, and $^{46}Ti^{35}Cl^+$ were measured, respectively, in the frequency range of 323 to 424 GHz. All three spin-orbit components were observed. The irregular fine structure splittings indicate that two spin-orbit ladders are perturbed by an excited $^3\Delta_r$ electronic state. Rotational, spin-orbit, and spin-spin parameters have been determined from the data and agree well with past optical studies. This study illustrates the power of velocity modulation for ion selectivity at millimeter/sub-mm wavelengths.