OPTICAL STARK AND PUMP/PROBE MICROWAVE OPTICAL DOUBLE RESONANCE SPECTROSCOPY OF GAS-PHASE CHROMIUM MONONITRIDE AND VANADIUM MONONITRIDE

J. SCOTT ROBINSON, KEI-ICHI NAMIKI, D. M. GOODRIDGE and T. C. STEIMLE, *Department of Chemistry and Biochemistry, Arizona State University, Tempe, AZ 85287.*

High resolution optical spectroscopic studies of gas-phase chromium mononitride, CrN, and vanadium mononitride, VN, using molecular beam techniques have been performed. The $R_{ee}(0.5)$ branch feature of the (0,0)$A^4\Pi_{3/2} - X^4\Sigma^-_{1/2}$ band system for ^{52}CrN was recorded as a function of the static electric field in the range 1.2 - 2.0 kV/cm. The resultant Stark shifts were analyzed to produce permanent electric dipole moments of 2.31(4)D and 5.41(2)D for the ground $X^4\Sigma^-_{1/2}$ and excited $A^4\Pi_{3/2}$ states, respectively. The $P_e(1)$, $F'' = 2.5$ feature of the (0,0) $D^3\Pi_0 - X^3\Delta_1$ band system for $^{51}V^{14}N$ (I=3.5) was also recorded as a function of static electric field in the range .4 - 1.2 kV/cm. The permanent electric dipole moments derived from a least squares analysis of the Stark shifts were 3.07(1)D for the ground $X^3\Delta_1$ state and 6.15(3)D for the excited $D^3\Pi_0$ state.
The $^{52}Cr^{14}N$ (I=1) hyperfine structure was determined from the analysis of 12 components of the lowest pure rotational levels using the pump/probe microwave-optical double resonance technique. The resulting parameters are (in cm^{-1}) $B'' = .62387360(74)$, $B' = .6060(1)$, $\gamma'' = .0070050(13)$, $\lambda'' = 2.611151(16)$, eqQ_0(^{14}N) = -.000025(10), b_F(^{14}N) = .0000062(34) and c(^{14}N) = -.000151(92). Comparisons to other experimental work and theoretical bonding models are given[a]. Observed trends amongst the early transition metals will be discussed.

[a]Walter J. Balfour, Charles X. W. Qian and Chi Zhou, *J. Chem. Phys.* **106**, 4383 (1997); James F. Harrison, *J. Phys. Chem.* **100**, 3513 (1996); Margareta R. A. Blomberg and Per E. M. Siegbahn, *Theor. Chim. Acta.* **81**, 365 (1992).