ELECTRONIC SPECTROSCOPY OF VH AND VD: NEW BANDS IN THE RED REGION

THOMAS D. VARBERG, NATHAN T. BRANDES, NICK J. IHRKE and KEVIN A. TOVAR, *Department of Chemistry, Macalester College, 1600 Grand Ave., St. Paul, MN, USA*

The first gas-phase spectrum of VH, assigned as the $\mathrm{D}^5\Pi$–$\mathrm{X}^5\Delta$ transition at 654 nm, was recently recorded and analyzed in our laboratory.[1] We have now identified additional bands of VH (at 715 nm) and VD (at 715 and 770 nm), for which rotational analyses are currently being undertaken. At this stage, the 715-nm band of VH has been assigned as arising from the $\mathrm{C}'^5\Delta$–$\mathrm{X}^5\Delta$ transition. All three bands are red-degraded and display complex rotational structures owing to the molecule's high spin multiplicity, rapid spin-uncoupling, large upper state Λ-doubling, and presence of strong local perturbations. We are also recording dispersed fluorescence spectra for many of the excitation transitions, which are a valuable aid for assigning the 15 rotational branches of the main sub-bands of these quintet systems. In each case fluorescence is observed to the v = 1 level of the $\mathrm{X}^5\Delta$ state, enabling us to determine the $\Delta G_{1/2}$ vibrational intervals of the electronic ground states of VH and VD. The molecules were produced by sputtering vanadium in a hollow cathode source with a dilute mixture of hydrogen or deuterium in argon. The spectra were recorded by laser excitation spectroscopy at Doppler-limited resolution using a continuous-wave ring dye laser. It is hoped that these results will be useful for astronomical searches for vanadium hydride in colder (L-type) stars within our galaxy.

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