STRONG VIBRONIC COUPLING IN THE VISIBLE SPECTRUM OF ZIRCONIUM METHYLIDYNE

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Zirconium methylidyne, ZrCH, can be prepared by the reaction of methane (8% in helium) with laser-ablated zirconium atoms. At least 50 vibrational bands have been observed in the $565 - 665$ nm region for each of ZrCH and ZrCD using laser-induced fluorescence. Dispersed emission spectra have allowed the assignment of numerous excited vibrational levels in the $\tilde{X}^2\Sigma^+$ ground state (17 for ZrCH, 22 for ZrCD and 9 for $Zr^{13}CH$). The ground state bond lengths, as determined from high-resolution spectra of ZrCH and ZrCD, are $r_0(Zr-C) = 1.83067(13)$ Å and $r_0(C-H) = 1.0866(9)$ Å. P' values derived from rotational analyses of 20 subbands in the electronic spectrum (9 of ZrCH and 11 of ZrCD) reveal a very complicated level structure. Preliminary vibrational assignment suggests the presence of two interacting excited states, $^2\Pi$ and $^2\Delta$, about 250 cm^{-1} apart. Many vibronically-induced bands consequently appear with unusual properties such as anomalous branch intensity patterns or upper levels with very large electrostatic (Renner-Teller) splittings between their angular momentum components.

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