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.

---

*Present address: Creo Inc., 3755 Willingdon Avenue, Burnaby, BC, Canada V5G 3H3*