RESONANT TWO-PHOTON IONIZATION SPECTROSCOPY OF JET-COOLED OsC

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The optical spectrum of diatomic OsC has been investigated for the first time, with transitions recorded in the range from $17,390$ to $22,990\ cm^{-1}$. The ground state was found to be $X^3\Delta_3$, deriving from the $4\delta^3 16\sigma^1$ electronic configuration. Six bands were rotationally resolved and analyzed to obtain ground and excited state rotational constants and bond lengths. Spectra for six OsC isotopomers, $^{192}Os^{12}C\ (40.3\%)$, $^{190}Os^{12}C\ (26\%)$, $^{189}Os^{12}C\ (16\%)$, $^{188}Os^{12}C\ (13.1\%)$, $^{187}Os^{12}C\ (1.9\%)$ and $^{186}Os^{12}C\ (1.6\%)$, were recorded and rotationally analyzed. Four bands were found to originate from the $X^3\Delta_3$ ground state, giving $B_0^{''} = 0.533492(33)$ cm^{-1} and $r_0^{''} =\ 1.67267(5)\ \mathring{A}$ for the $^{192}Os^{12}C$ isotopomer (1σ error limits); two of these the 0-0 $[19.1]\,2\ \leftarrow\ X^3\Delta_3$ and 1-0 $[19.1]\,2\ \leftarrow X^3\Delta_3$ bands, form a vibrational progression with $\Delta G_{1/2}^{'} =\ 953.019\ cm^{-1}$. The remaining two bands were identified as originating from an $\Omega^{''} = 0$ level that remains populated in the supersonic expansion. We believe that this level corresponds to the low-lying $A\ ^3\Sigma_{0+}^-$ state, which derives from the $4\delta^2 16\sigma^2$ electronic configuration. The OsC molecule differs from the isovalent RuC molecule in having an $X^3\Delta_3$ ground state, rather than the $X^1\Sigma^+$ ground state found in RuC. This difference in electronic structure is due to the relativistic stabilization of the 6s orbital in Os, an effect which favors occupation of the $6s-$like 16σ orbital. The relativistic stabilization also lowers the energy of the $4\delta^2 16\sigma^2$, $^3\Sigma^-$ term, allowing this term to remain populated in the supersonically cooled molecular beam.