THE ELECTRONIC SPECTRUM OF CoO IN THE VISIBLE REGION

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Fluorescence excitation spectra of gaseous CoO have been obtained following the reaction of laser-ablated cobalt metal with oxygen under supersonic jet-cooled conditions. Nearly 100 bands arising from the $^4\Delta_{7/2}$ component of the ground state are found in the wavelength region 430 - 720 nm. The bands are all very strongly red-degraded and many of them are rotationally perturbed. Combining the new spectra with previous Doppler-limited intracavity laser-induced fluorescence spectra, it is found that the bands in the region 580 - 720 nm go to four excited electronic states, $C^4\Delta$, $D^4\Phi$, $E^4\Delta$ and $F^4\Delta$. The spin-orbit coupling and hyperfine structure indicate that the three close-lying $^4\Delta$ states (which lie within 1300 cm^{-1}) all come from the same electron configuration $\sigma_{4s}\pi^2\delta^3\sigma_{3d}$. Calculations of the electron-electron repulsion matrix elements for this configuration, together with values for the exchange integrals transferred from the TiO spectrum, are nicely consistent with such an assignment. At shorter wavelengths the spectrum is very confused, though four upper state vibrational progressions (three with Ω = 7/2 upper states and one with Ω = 9/2) can be assigned.