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Spectroscopic and Magnetic Susceptibility Analyses of the ^7F_J and $^5\mathbf{D}_4$ Multiplet Manifolds of $\mathbf{Tb}^{3+}(\mathbf{4f}^8)$ in $\mathbf{TbAlO}_3$ KELLY NASH, JOHN GRUBER, DHIRAJ SARDAR, University of Texas at San Antonio, UYGUN VALIEV, ABDULLA UZOKOV, National University of Uzbekistan, GARY BURDICK, Andrews University — Detailed analyses of temperature-dependent spectroscopic and magnetic susceptibility data are reported for the crystal-field split energy levels of the $^7\mathrm{F}_J$ and $^5\mathrm{D}_4$ of Tb^{3+} TbAlO_3. The spectroscopic data include absorption spectra obtained between 480 and 2940 nm from 8 to 300 K. High resolution fluorescence spectra are reported, representing transitions from $^5\mathrm{D}_4$ to$^7\mathrm{F}_{6,5,4}$, at a sample temperature of 85 K. Using crystal-field modeling techniques recently adapted for low symmetry systems, we have assigned all 58 experimental Stark levels within the $^7\mathrm{F}_J$ and $^5\mathrm{D}_4$ manifolds, with a fitting standard deviation of 4.5 cm^{-1} (3.8 cm^{-1} rms error). Furthermore, the theoretical Stark levels and calculated wavefunctions were used to determine the temperature dependence of the magnetic susceptibility along the c-axis of the TbAlO_3 crystal. Agreement is obtained between the calculated susceptibility and temperature-dependent magnetic data reported earlier. The susceptibility calculation also confirms the predicted ordering of states within the $^7\mathrm{F}_6$ multiplet manifold.

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