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High-pressure optical spectroscopy and X-ray diffraction studies on synthetic cobalt aluminum silicate garnet

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Abstract

The pressure-induced behavior of spin-allowed *dd*-bands of $^{VIII}Co^{2+}$ in the absorption spectra of synthetic $Co_3Al_2Si_3O_{12}$ garnet was studied from 10^{-4} to 13 GPa. The plots of the peak energy vs. pressure for the three sharpest well resolved bands at ca. 5160, 17 680, and 18 740 cm^{-1} display small but discernible breaks in linear relations between 4 and 5 GPa. Data from single-crystal X-ray diffraction likewise show discontinuities in trends of CoO_8 polyhedral volume and distortion, and Co-O and Si-O bond distances over this pressure range. These effects are related to a pressure-induced phase transition from the β- to α-isostructural polymorph of $Co_3Al_2Si_3O_{12}$.

Keywords: High-pressure optical spectroscopy, high-pressure X-ray diffraction, cobalt-bearing garnet, phase transitions