

## **Intervalence charge transfer in aluminum oxide and aluminosilicate minerals at elevated temperatures**

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### **ABSTRACT**

Single-crystal optical spectra of corundum ( $\text{Al}_2\text{O}_3$ ) and the  $\text{Al}_2\text{SiO}_5$  polymorphs andalusite, kyanite, and sillimanite, containing both  $\text{Fe}^{2+}$ - $\text{Fe}^{3+}$  and  $\text{Fe}^{2+}$ - $\text{Ti}^{4+}$  intervalence charge transfer (IVCT) absorption bands were measured at temperatures up to 1000 °C. Upon heating, thermally equilibrated IVCT bands significantly decreased in intensity and recovered fully on cooling. These trends contrast with the behavior of crystal field bands at temperature for Fe, Cr, and V in corundum, kyanite, and spinel. The effects of cation diffusion and aggregation, as well as the redistribution of band intensity at temperature, are also discussed. The loss of absorption intensity in the visible and near-infrared regions of the spectrum of these phases may point to a more general behavior of IVCT in minerals at temperatures within the Earth with implications for radiative conductivity within the Earth.

**Keywords:** Intervalence charge transfer, temperature dependence, corundum, andalusite, kyanite, sillimanite