

## OPTICAL SPECTROSCOPY OF PYROXENES

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Studies of the optical spectra of pyroxenes are concerned with the physics of the interaction of light with minerals, with crystallographic site occupancy and analytical concentration of ions, and with applications to problems in the Earth and Materials sciences.

Single crystal absorption spectra have been obtained for  $\text{Cr}^{3+}$ ,  $\text{Mn}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ , and  $\text{Cu}^{2+}$  in natural and synthetic orthopyroxenes. Spectra are also known for monoclinic pyroxenes containing  $\text{Ti}^{3+}$ ,  $\text{V}^{4+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Mn}^{3+}$ , and  $\text{Fe}^{3+}$  and the spectra of protopyroxene containing  $\text{V}^{3+}$ (?). Only for  $\text{Fe}^{2+}$  -containing orthopyroxenes have absorption intensity vs concentration curves been determined. Interactions between cations in different valence states (e.g.  $\text{Fe}^{2+}/\text{Fe}^{3+}$  and  $\text{Fe}^{2+}/\text{Ti}^{4+}$ ) are being studied in augite to understand their impact upon analytical  $\text{Fe}^{2+}/\text{Fe}^{3+}$  determinations, in aegirine to examine the origin of such inter-valence interactions, and in lunar and meteoritic minerals to address problems of cation oxidation state. Color zoning can often be understood from optical studies of iron oxidation states in sector and core-rim zones pyroxenes. Manganese ions in pyroxenes are especially susceptible to oxidation-reduction changes and energy transfer in response to external radiation. Manganese in spodumene has been studied to follow gamma-ray radiation induced redox changes and both gamma-ray and ultraviolet luminescence processes. Of the ions studied so far, only  $\text{Fe}^{2+}$  has shown appreciable tendencies to undergo site population re-equilibration with heat-treatment.