American Mineralogist, Volume 96, pages 1537–1546, 2011

Raman spectroscopy of titanomagnetites: Calibration of the intensity of Raman peaks as a sensitive indicator for their Ti content

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Abstract

A systematic study of the Raman spectra of the titanomagnetite solid-solution series ($Fe_{3-x}Ti_xO_4$) for x = ~0.0, 0.2, 0.4, and 0.6 has been conducted. The samples showed combinations of five previously predicted Raman peaks at ~190, 310, 460, 540, and 670 cm^{-1} that correspond to vibrational modes with $T_{2g}(1)$, E_g, $T_{2g}(3)$, $T_{2g}(2)$, and A_{1g}, respectively. The calibration of Raman spectra for titanomagnetite with known values of Ti concentrations reveals a strong dependence of relative intensity for the $T_{2g}(2)$ and $T_{2g}(3)$ modes on Ti concentration. The most prominent feature is the appearance and increase in the relative intensity of a $T_{2g}(3)$ peak above x = ~0.2. On the other hand, the Raman peak for the $T_{2g}(2)$ mode gradually diminishes as Ti increases and nearly disappears at x = ~0.6. Combining the two relative intensities potentially provides a sensitive indicator of Ti content. The technique was applied to study titanomagnetite in grains from Hana Volcanics and melatroctolite from Rhode Island.

Keywords: Titanomagnetites, Raman spectroscopy, Fe-Ti oxides, spinel