OXIDATION OF SYNTHETIC AND METEORITIC FE-RICH OLIVINE BY HEATING IN AIR.

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In-situ mid-infrared transmission measurements of matices from the Vigarano and Ningqiang carbonaceous CV chondrites heated up to 572 °C in air were conducted by a FTIR spectroscopy. The FTIR spectra of the matrices mainly showed olivine features. With increasing temperature, the spectra did not show significant spectral changes except band shift to higher wavelength up to 477 °C. However, at 572 °C, the spectra showed a splitting of ~11 micron band and the relative intensity of ~10 micron to ~11 micron largely increased. We also examined recovered samples of synthetic Fe-rich olivine (Fo_{47}) heated at 600 °C in air. The mid-infrared spectra of the olivine showed similar spectral changes to those of meteoritic samples.

In TEM observation, Vigarano and Ningqiang samples after cooling are mainly consists of olivine and pyroxene and lesser amount of Si-rich glass, kamacite and hematite. Selected area electron diffraction (SAED) patterns of a part of olivine grains in both samples showed streaking along c^*_{ol} axis suggesting stacking disorder on (001) plane. SAED patterns of some olivine grains in Ningqiang showed diffraction spots correspond to those of magnetite. The interlayered olivine and magnetite exhibited the following crystallographic orientation: $(100)_{ol}$ // $(111)_{mg}$ and $(001)_{ol}$ // $(101)_{mg}$. Many of grains in Vigarano and Ningqiang showed diffraction patterns different from the interlayered olivine and magnetite. The SAED pattern of the grains showed extra spots along c^*_{ol} direction in addition to streaking along c^*_{ol}. These extra spots correspond to a superstructure of three-fold periodicity along c_{ol}. This superstructure is known as laihunite-3M which has an olivine structure with a composition of $Fe^{2+}_{2-3x}Fe^{3+}_{2x}SiO_4$ [1,2].

The synthetic Fe-rich olivine before heating does not have any defect structures. However, heated Fe-rich olivine commonly has stacking disorder and laihunite lamellae on $(001)_{ol}$ as well as olivine in heated Ningqiang. Therefore, the changes in mid-infrared spectra of the matrices of Vigarano and Ningqiang would not have been caused by chemical reactions among their constituent minerals or partial melting, but would mainly caused by oxidation of iron in olivine. These FTIR features could be reference data for search for laihunite on the Martian surface and in partially oxidized meteorites or asteroidal surfaces.

References: [1] Kiramura M. et al. 1984. *American Mineralogist* 69:154-160. [2] Shen B. et al. 1986. *American Mineralogist* 71:1455-1460.