VIS/NIR reflectance spectra measurements of synthesized pyroxenes:Implications for mineral on lunar surface

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1. Introduction

Visible to near-infrared (VIS/NIR) reflectance spectra of natural pyroxenes have been measured since the Apollo projects. In general, several transition metals (Fe, Mn, Ti etc) are contained in natural samples, and these elements yield complex spectra because of the combination of absorption features from each transition-metal element. It is difficult to quantify the effects of these elements on the spectral reflectance of natural pyroxenes. For arguments of systematic spectral variations without effects of transition metals except iron, it would be useful to measure the reflectance spectra of synthesized pyroxenes. In this work, we measured the VIS/NIR reflectance spectra of pyroxenes synthesized in the MgO-FeO-CaO-SiO2 system, and analyzed the spectra with the modified Gaussian model (MGM), in order to establish the new systematic compositional model.

2. Experimental procedure

Pyroxene samples were synthesized at high pressure with the multi-anvil apparatus in the 1000 ton uniaxial press and the MS-800 type piston-cylinder apparatus. The synthetic pyroxenes were augite and orthopyroxene. Micro-Raman spectroscopy and Micro-Area X-ray Diffractometer were used for identification of the phases. The analysis of the composition was made by EDS. Grain size of all samples ranges from 75 to 105um. We measured the visible and near-infrared reflectance spectrum using a JASCO VIS-NIR reflectance spectrometer at Japan Aerospace Exploration Agency (0.3-2.6um in wavelength). Incidence and emission angles were 30 degrees and 0 degree, respectively.

3. Results

Reflectance spectra of the pyroxenes were analyzed with the modified Gaussian model (MGM) method. We found the relations between the absorption wavelength and Fe#(=FeO/(MgO+FeO+CaO)) or Ca#(=CaO/(MgO+FeO+CaO)) and compared the results with those of natural pyroxenes (Adams, 1974; Cloutis, 1991).