

Cathodoluminescence characterization of enstatite in meteorites.

OHGO, Syuhei^{1*} ; NISHIDO, Hirotsugu¹ ; NINAGAWA, Kiyotaka¹

¹Okayama University of Science

Enstatite in meteorites occasionally shows various cathodoluminescence (CL) emissions with red, reddish purple and blue, whereas terrestrial enstatite has almost no CL emission. We have confirmed several luminescent enstatite in enstatite chondrite (E-chondrite) and enstatite achondrite (Aubrite). In this study, we have conducted to clarify the luminescence centers of CL emissions in extraterrestrial enstatite compared to the CL of terrestrial enstatite.

The polished thin sections of E-chondrites (Sahara 97096, Sahara 97121, Dar al Gani 734 and Y 86004) and Aubrite (Al Haggounia 001) were used for CL measurements. Color CL images were obtained using a cold-cathode type Luminoscope with a cooled-CCD camera. CL spectroscopy was made by a SEM-CL system, which is comprised of SEM (JEOL: JSM-5410LV) combined with a grating monochromator (OXFORD: Mono CL2). The CL emitted from the samples was dispersed by a grating (1200 grooves/mm), and recorded by a photon counting method using a photomultiplier tube. All CL spectra were corrected for total instrumental response, which was determined using a calibrated standard lamp.

Color CL imaging reveals various types of CL emissions with red, reddish purple and blue in the extraterrestrial enstatite. The CL spectra of these enstatite show a broad emission band at 670 nm in a red region, which is assigned to an impurity center derived from activated divalent Mn ion substituted for Mg, and a broad emission band at around 400 nm in a blue region, which might be related to a defect center possibly assigned to "intrinsic defect center" derived during crystal growth.

CL spectra were converted into energy units for spectral deconvolution using a Gaussian curve fitting, because one Gaussian curve in energy units should correspond to one specific type of emission center (Stevens-Kalceff, 2009). The deconvoluted components can be assigned to the emission centers related to impurity centers of trivalent Cr ion at 1.64 eV and divalent Mn ion at 1.86 eV and two defect centers at 2.71 and 3.18 eV. The emission component at 3.18 eV might be attributed to the defect center of structural distortion by the substitution of Al ion for Si in a tetrahedral site, which is possible to be in the process of crystal growth at high temperature in its parent body (e.g., the rocks hosting Al-rich enstatite formed at depths from 25 km to 130?200 km in the lunar rock; Nazarov et al., 2011). Al contents in blue luminescent enstatite are higher than that in red luminescent one. Blue emission center can be detected in the CL of terrestrial samples.

Keywords: Enstatite, Cathodoluminescence, E-chondrite, Emission center