Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P02 Room:Convention Hall Time:May 25 14:00-16:30

Cathodoluminescence characterization of forsterite in Kaba meteorite (CV3)

Taro Endo[1*], Arnold Gucsik[2], Hirotsugu Nishido[1], kiyotaka ninagawa[3], Masahiro Kayama[1]

[1]Okayama University of Science, [2]Max Planck Institute, [3]Okayama University of Science

The Kaba meteorite is the most primitive unshocked CV fall (in 1857) collected nearby Kaba village, East Hungary. This meteorite is subdivided into Bali-like CV3 chondrite by the reason of a similarity to the Allende meteorite. This meteorite contains porphyritic olivine-, granular and radial pyroxene-, and barred olivine chondrules, which are surrounded by magnetite and sulfide assemblages. The study of the refractory inclusions (CAI) indicates maghemite with inverse-spinel structure and higher FeO content in inner with lighter oxygen isotope ratio, whereas the outer part consist of MgO-spinel and scattered perovskite grains. The Kaba meteorite experienced aqueous alteration and contains hydrous phyllosilicates with altered features in constituent materials.

Cathodoluminescence (CL) emissions can occasionally be detected from olivine, especially forsterite, in meteorites, whereas terrestrial one mostly gives no luminescence. CL spectroscopy and microscopy provide useful information about the existence and distribution of lattice defects and trace elements in materials with high-spatial resolution of a few micron meters. In this study, therefore, CL of the forsterite in various types of chondrules has been characterized to clarify origin of the chondules in the Kaba meteorites.

Highly forsteric olivine (Fo: 99.2?99.7) in the Kaba meteorite emits bright cathodoluminescence (CL), whereas the olivine containing fayalitic composition, even if only slight, shows no luminescence due to quenching effect of divalent Fe ions. Red luminescent forsterite is predominant, but occasionally zoned forsterite shows blue in the core and red in the rim. CL spectra of red luminescent forsterite have two broad emission bands at approximately 630 nm in red region and over 700 nm in red?IR region. The former band can be assigned to impurity center of divalent Mn ion as an activator. The latter one shows a magnificent red emission in a wide range of wavelength responsible for trivalent Cr ions, which possess two components of Cr activator and structural defect caused by interstitial Cr ions. CL spectra from blue luminescent area in the core give a characteristic broad band emission at approximately 400 nm, also associated with minor red emissions related to Mn and Cr ions. EPM analysis reveals that the concentrations of Ca, Al and Ti increase toward the center of the grain. In this case, the quenching effect of divalent Fe ions on CL might be slight and homogeneous over a forsterite grain due to low and unvaried concentration of Fe. Therefore, CL color variation observed in Kaba forsterite should be attributed mostly to intrinsic structural defect, of which distribution cannot be detected by any other methods. It implies that aqueous alteration on the forsterite might eliminate intrinsic structural defects progressively from the rim of the grain to the core, accompanied by the migration of diffusible ions of Mn, Cr and Fe to the rim where Ca and Al ions might still lie in the core. This process could proceed at low temperatures (<300?C) over a short reaction time.

Keywords: Kaba meteorite, Forsterite, Cathodoluminescence