Blue cathodoluminescence of alkali feldspar activated by Ti^{4+} impurity center and Al-O^{-}-Al defect center

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Cathodoluminescence (CL) of alkali feldspar has been used as an important tool to characterize their texture for clarifying the cooling history. However, only a few detailed assignments of their blue luminescence have been made for natural samples, although there are two possible emission centers, Ti^{4+} impurity and Al-O^{-}-Al defect centers. CL of alkali feldspar has been studied to clarify emission centers for its blue CL color by spectral analysis.

Alkali feldspar in a quartz syenite from the Patagonian Andes, Chile was used, because it shows a variable combination of blue CL color and red CL color varying with microtextures. It exhibits various microtextures such as clear feldspar formed by magmatic process at 750 ^{o}C and patch microperthite (PMP) produced by subsequent hydrothermal metasomatic reaction at 250 ^{o}C. A scanning electron microscopy-cathodoluminescence (SEM-CL) was conducted to obtain CL spectra ranging from 300 to 800 nm using an SEM (JEOL: JSM-5410) combined with a grating monochromator (Oxford: Mono CL2).

CL spectra of CF and Ab-rich PMP with high TiO_2 content (0.017 wt.%) show a blue narrow emission band at around 400 nm and broad one at around 420 nm, respectively. Both emission bands can be fitted by two Gaussian curves in the energy unit. This fitting results in the deconvolution of CL spectra using two Gaussian curves at 3.04 eV and 2.90 eV. An integral intensity of peak at 3.04 eV positively correlates with the Ti impurity content. It indicates that peaks at 3.04 eV can be assigned to Ti^{4+} impurity center. CF has five to ten times higher integral intensity of the peak at 2.90 eV than the microtexture formed by a hydrothermal metasomatic reaction. The intensity has a negative correlation with Fe_2O_3 impurity content or CL intensity of red emission caused by Fe^{3+} impurity center, suggesting a characteristic of Al-O^{-}-Al structural defect estimated by ESR analysis. It implies that CL emission peaked at 2.90 eV is responsible for Al-O^{-}-Al defect center.