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Radiation effects on cathodoluminescence of albite

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Abstract

He^+ ion implantation on albite (Minas Gerais, Brazil) at 4.0 MeV, corresponding to the energy of α particle from ^{238}U fission, has been conducted to clarify the radiation effects of α particles from radioactive minerals on cathodoluminescence (CL) of albite. CL of albite results in various emission bands at ~380, ~560, and ~740 nm, and in the UV range. Red emission at 700–750 nm is detected in the CL spectra of the implanted samples. Total CL intensities of these UV, blue, yellow, red, and IR emissions vary among the samples. High-resolution CL imaging of the cross-section samples shows a CL halo on the implanted surface of approximately 14 μm thickness, which is consistent with a theoretical range of α particles of 4.0 MeV. It was first confirmed experimentally that the CL halo is created by α particles. The deconvolution of CL spectra in the red emission range by Gaussian fitting provides the component at 1.861 eV that is attributed to a radiation-induced defect center produced by He^+ ion implantation. The intensity of the component at 1.861 eV linearly correlates with the dose density of He^+ implantation on albite as a function of the population of the radiation-induced defect center, regardless of other factors such as concentration and distribution of other emission centers, existence of microstructures and textures, and crystallographic orientation. The CL spectral deconvolution has a high potential for quantitative evaluation of the radiation dose of α particles from natural radionuclides on albite for a geodosimetry.

Keywords: Cathodoluminescence, albite, radiation-induced defect center, He^+ ion implantation, cathodoluminescence halo, cathodoluminescence spectral deconvolution