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The influence of annealing on radioluminescence and thermally stimulated luminescence in natural quartz

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Abstract content
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The kinetics of the main thermoluminescence peak in natural quartz have been investigated for glow curves measured between 30 and 500oC. For an irradiation dose of 10 Gy and heating at 5.0oC/s, the main peak is found at 92 oC for an unannealed sample and at 86 oC for a sample pre-annealed at 500 oC. Re-using a sample leads to an enhancement of the main peak, a feature possibly due to sensitization. The peak position is independent of dose and this, together with its fading characteristics are consistent with first-order kinetics. The dose response of the main thermoluminescence peak of each sample is linear for doses less than 10 Gy, becomes sub-linear up to 60 Gy and changes to linear again with doses up to 150 Gy. The half-life of the main peak for the unannealed sample is 1.3 h and that of the annealed sample is 1.2h. The main peak of each sample, which can be approximated to a first-order peak, has an activation energy of about 0.93 eV. The intensity of the main peak in each case decreases with heating rate. This is evidence of thermal quenching. Complementary radioluminescence emission spectra were also measured for quartz annealed at various temperatures. Emission bands in quartz are affected by annealing and irradiation. A strong enhancement of the 3.4 eV (˜ 366 nm) emission band is observed following annealing at 500oC. A new emission band whose intensity increases with annealing up to 1000oC is observed at 3.7 eV (˜ 330 nm) for quartz annealed at 600oC. We correlate the changes in radioluminescence emission spectra due to annealing with the influence of annealing on luminescence lifetimes in quartz.

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