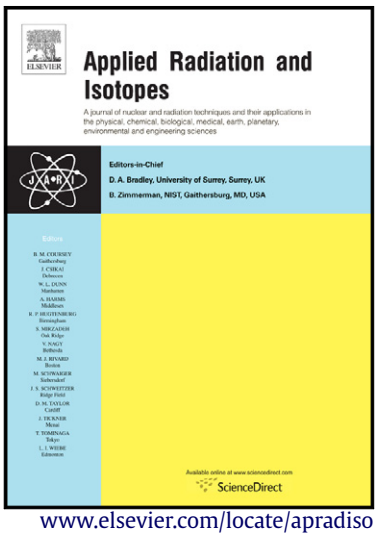

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Effect of Heating Rate on the Thermoluminescence and Thermal Properties of Natural Ulexite

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Abstract

Boron-rich compounds are of interest in the nuclear industry because they exhibit a high neutron absorption cross section. The manufacture of these materials involves the application of thermal and chemical treatments. This paper focuses on the study of the effect of the heating rate (HR) in two thermal techniques, differential thermal analysis (DTA) and thermoluminescence (TL), performed on natural ulexite from Bigadiç-Balıkesir (Turkey). The TL measurements were performed at six different heating rates in the range of 25–240°C·min^{-1}. The UV–blue TL emission of natural ulexite shifted toward higher temperatures with increasing heating rate, whereas the intensity decreased. The kinetic parameters of the ulexite (E_a=0.65(9) eV and s=1.22·10^{12} s^{-1}) were calculated using the variable heating rate method. DTA measurements performed in the range of 0.5–10°C·min^{-1} displayed similar behavior to that of the TL response, despite the differences in technique and HR values. The DTA results indicated that natural ulexite exhibits two endothermic peaks originating from different processes: (i) a phase transition between the pentahydrated ulexite phase and a triple-hydrated phase and (ii) dehydration, dehydroxylation and alkali and earth-alkali self-diffusion processes in the ulexite lattice. The main endothermic peak shifted from 160º C to 250°C as the heating rate was increased.

Keywords: thermoluminescence, heating rate, differential thermal analysis, ulexite, borates

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