LUMINESCENCE OF CALCIUM OXIDE AFTER PULSED ELECTRON IRRADIATION

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High purity crystals of CaO and CaO doped with a nominal 1% MgO show luminescence emission bands at 375 and 410 nm after irradiation at room temperature with 6 ns duration pulses of 500 keV electrons from a Febetron 706 source. No other emissions are observed over the range 200 to 800 nm as a consequence of the electron irradiation. The emission intensity decreases as the electron energy is reduced and is not observed below 300 keV.

The emission is fully developed immediately after the electron pulse, and a log-log plot of intensity versus time over the range 10^{-8}s to 10 s shows several interesting features. Approximately unimolecular kinetics are followed in 3 distinct time zones: 0-3μs, 30μs-200μs; after 10 ms. Higher order kinetics are followed over the time intervals 3μS-30μs and 200μs-10 ms.

The emission wavelengths are characteristic of the luminescence emission of the F^+ center (375 nm) and the F_A^+ center (410 nm) (Henderson 1980). The F^+ center is a single electron trapped in an oxygen vacancy and the F_A^+ center is a single electron trapped in an oxygen vacancy with one nearest neighbour calcium cation replaced by magnesium. Since the incident electron energy required to displace an oxygen anion is around 330 keV (Chen et al., 1970), we may conclude that the emissions arise from centers created by irradiation. However, this conclusion is at variance with those of Williams et al. (1979) for pulsed electron irradiated MgO, who suggest that the emission is due to an electron-hole recombination occurring at a cation vacancy.

In conjunction with electron spin resonance and thermoluminescence studies, these measurements should give information on the processes involved in the formation of stable defects in calcium oxide.

REFERENCES

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