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Autor: Brovetto, P. / Delunas, A. / Maxia, V.

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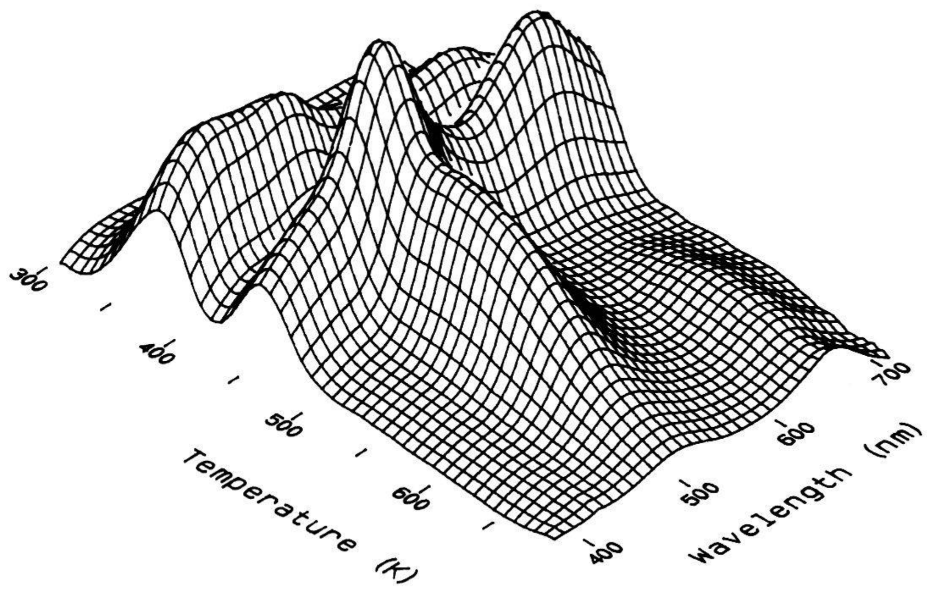
THERMOLUMINESCENCE OF CALCIUM FLUORIDE

P.Brovetto, A.Delunas, V.Maxia and G.Spano
Gruppo Nazionale di Struttura della Materia del C.N.R.
Istituto di Fisica Superiore dell'Università, Cagliari, Italy.

The thermoluminescent (TL) emission of X-ray activated calcium fluoride (CaF_2, S.G. Fm3m) was investigated by means of a spectral resolution technique in the 375 to 730 nm range. Samples of different origin, not intentionally doped, were examined; they are: A) supplied by Aldrich, purity 99.99 %; B) supplied by C.Erba, purity 99.9 %; C) prepared by ionic exchange from a watery solution of $CaCl_2$ and NH_4F , purity 99.9 %. TL emission was recorded using both untreated samples and samples heated for 1 hour at temperatures above 1000 °C. The fig. shows, as an example, the tridimensional plot of an untreated



A) sample. It appears that TL intensity is represented by emission ridges parallel to the wavelength axis. In the fig., however, two smooth ridges parallel to the temperature axis are also present. These features are readily interpreted on the grounds of kinetic models. It can be shown that when electrons released from traps of depth E recombine with different (i,j-th) luminescent centres the temperatures T_i, T_j of maximum emission are linked by

$$(T_i - T_j)/T_m = (kT_m/2E)\ (T_m/\Delta T_i - T_m/\Delta T_j)\ ,$$

where $T_m = (T_i + T_j)/2$, while ΔT_i, ΔT_j mean the after-maximum glow widths. In practice, the ratios $T_m/\Delta T_i$, $T_m/\Delta T_j$ gauge the steepnesses of after-maximum descents. Since these steepnesses, as can be seen in the fig., are nearly constant, isothermicity of the TL emission is explained. As for ridges parallel to temperature axis, they are related to the presence of a sequence of electron traps of different depths, e.g. E_r, E_s. It can be shown as a first approximation that: $(E_s - E_r)/E_r = (T_s - T_r)/T_r$, T_r and T_s being the glow maxima temperatures. In the tab. some data are reported concerning untreated A) and B) samples and sample C) heated at 1300 °C. This sample did not show emission when heated

	A) (Yield 100)					B) (Yield 116)			C) (Yield 1400)
T(K)	382	386	389	459	468	395	405	405	465
λ(nm)	425	481	661	661	497	414	571	695	610

below 1200 °C. It is to be pointed out that the A) sample, when heated to 1300°C, exhibits the same emission of sample C). As concerns the nature of the electron traps, the complexity of the observed TL emission indicates the presence of clusters of F centres (R,M,N centres). The nature of the recombination centres constitutes an even more intriguing problem. The centre responsible for the 610 nm emission, present in samples treated at high temperature, is probably identifyable as the V_F centre. It is worth pointing out that samples heated to high temperatures exhibit a TL yield clearly higher than untreated ones. For instance (see the tab.), yield of sample C) is 1400 (arb. units) as compared with 100 and 116 of untreated samples A) and C), respectively.