DLTS fill-pulse effect on the emission rate enhancement in electron-irradiated highly doped p-type InP

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Deep traps in InP were the subject of intense work in the past. This material presents high performance and stability in the conversion of sunlight to electricity. It was found that irradiation of InP solar cells leads to creation of deep carrier traps. The effect of different fill-pulse parameters of Deep Level Transient Spectroscopy (DLTS) on the hole trap $H4_F$[1] in electron irradiated samples has been studied. The experimental measurements were made on highly doped InP (1.2×10^{17} cm^{-3}) irradiated at room temperature in the electron energy range 0.3-1.6 MeV. The emission rate enhancement, usually calculated on the basis of the electric field present at the boundary of the junction[2], does not agree well with the experimental results. Effectively the filled traps range in the depletion region, and hence the electric field strength to which these traps are subjected, depends on the fill-pulse amplitude. We have found that the experimental results could be explained on the basis of the enhancement of the emission rate of the $H4_F$ deep trap calculated using the phonon assisted tunneling model[3]. The calculated enhanced emission rates (Fig.1) fits better the experimental results when we take the value of the electric field at the point which limits the filled traps taking into account the non exponential part of the carrier capture kinetics.

In this paper, the role of Debay tail and the filling pulse amplitude are examined separately.

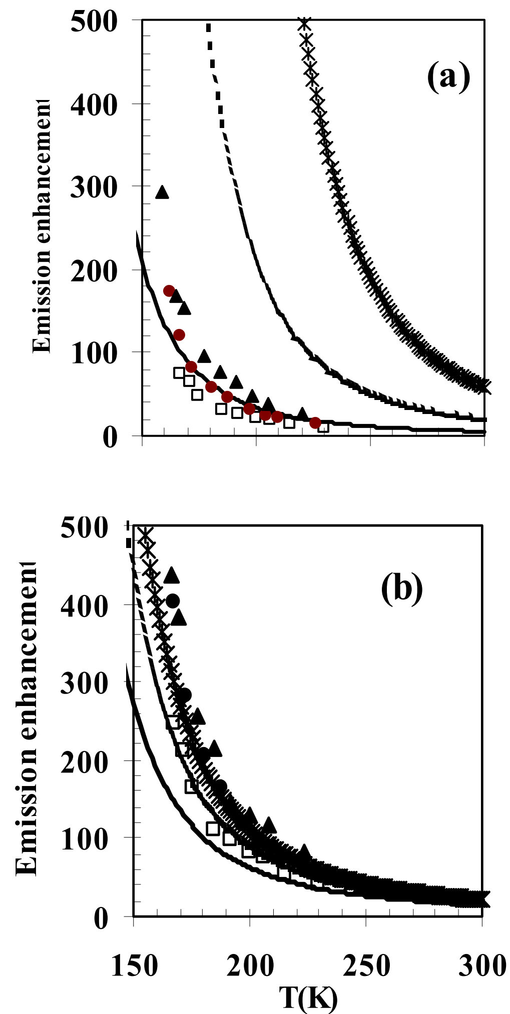

Fig.1: Experimental results of the emission rate enhancement of $H4_F$ obtained at $V_a = \Delta V$ = 1V (□), 2V(•) and 3V (▲). (a) Enhancement calculated for electric field stength at the junction boundary (—) V_a =1V, (---)V_a =2V and (***) V_a =3V and (b) Enhancement calculated at filling limit.

References:

[1]: B. Massarani, F. Awad, M. Kaaka, and R. Darwich, Phys. Rev. B58,15614 (1998).

[2]: S. R. Messenger, R. J. Walters, and G. P. Su,,ers, J. Appl. Phys., 71, 4201 (1992).

[3]; G. Vincent, A. Chantre, and D. Bois, J. Appl. Phys., 50,5484 (1979).