Recombination Kinetics in *a*-Si:H

Mort *et al.*[1] reinterpreted our data on the relaxation of photoinduced absorption (PA) in *a*-Si:H.[2] We want to show that the proposed interpretation contradicts one basic feature of the data while our original interpretation is in good agreement with experiment.

For analyzing the PA decay, Mort *et al.* used a set of linear equations involving diffusion, bulk, and surface recombination; in this description, the decay rates do not depend on the initial carrier concentration N_0. However, in our experiments we observed an intensity dependence of the decay rates mentioned before[2] and clearly seen in Fig. 1. In this figure, the decay of PA in *a*-Si:H at 80 K was measured on the same sample with the same equipment as described in Ref. 2 for two initial concentrations: curve *a*, $N_0 = 1.2\times10^{16}$ cm^{-3}, and curve *b*, $N_0 = 6\times10^{15}$ cm^{-3}. In the latter case, the decay is slower, especially at shorter times; at long times, both curves approach the same decay rate which is weaker than t^{-1}. Both cases can be simultaneously fit with use of our Eq. (5) (Ref. 2) with the same parameters ($\alpha = 0.7$; $\bar{b} = 2\times10^{-13}$ cm^3 s^{-1}) except N_0.

Besides the nonlinear feature, our interpretation differs from that of Mort *et al.*[1] by neglecting diffusion and surface recombination. Although these effects should be included in a complete theory, we believe that they are negligible in our case. We can estimate[2] the mobility $\bar{\mu}$ from $\bar{b}$ ($\bar{\mu} \simeq 5\times10^{-6}$ cm^2/V s at 80 K) and calculate the longest diffusion length $(Dt)^{1/2}(\simeq 0.06\ \mu$m) corresponding to the longest experimental time of 10^{-3} s. This length is much shorter than the absorption length of the exciting laser radiation of about 1 μm ($\alpha_L = 9.4\times10^3$ cm^{-1} at 80 K for $\hbar\omega_L = 2.1$ eV). At higher temperatures, when the diffusion and surface recombination may play a role at longer times, the PA decay is much shorter.[2]

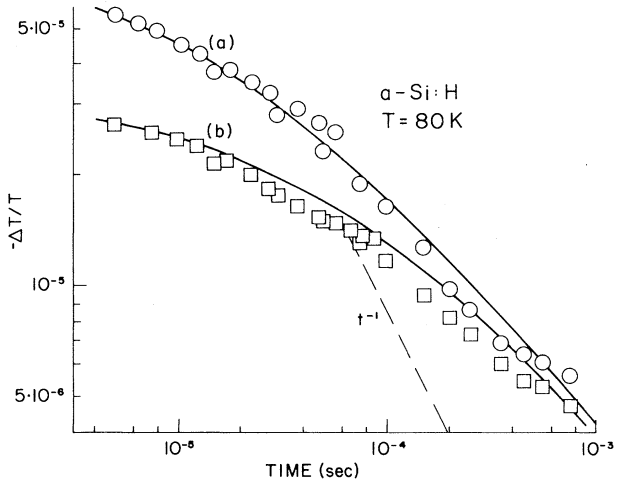

FIG. 1. Decay of photoinduced absorption. $-\Delta T/T$ is the fractional transmission change. Initial carrier concentration N_0 is twice as large in case *a* as in case *b*. Solid lines are fits to the data with use of Eq. (5) (Ref. 2).

In our interpretation, the dispersive transport is an essential feature while in the interpretation of Mort *et al.*, it is not. This is a fundamental difference in both approaches. Therefore, by showing that the interpretation based on the dispersive transport is in agreement with the experimental data while the other is not we provide additional evidence for the dispersive transport in *a*-Si:H.

Our objections do not apply to the interpretation of the experimental results of Mort *et al.* It is plausible that at the carrier concentration levels in their work which were much smaller than in our experiments, the recombination is monomolecular. Nevertheless, the pervasive evidence in favor of the dispersive transport in *a*-Si:H (time-of-flight measurements, photoinduced absorption, photoconduction, luminescence) makes one think about the possibility of an alternative explanation of their own data which would take into account the dispersive transport and would be better correlated with other experimental data and the present understanding of the carrier transport in this material.

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