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Reciprocal capacitance transients?[1] TIM GFROERER, PETER SIMOV, Davidson College, MARK WANLASS, NREL — When the reverse bias across a semiconductor diode is changed, charge carriers move to accommodate the appropriate depletion thickness, producing a simultaneous change in the device capacitance. Transient capacitance measurements can reveal inhibited carrier motion due to trapping, where the depth of the trap can be evaluated using the temperature-dependent escape rate. However, when we employ this technique on a $GaAs_{0.72}P_{0.28}$ n+/p diode (which is a candidate for incorporation in multi-junction solar cells), we observe a highly non-exponential response under a broad range of experimental conditions. Double exponential functions give good fits, but lead to non-physical results. The deduced rates depend on the observation time window and fast and slow rates, which presumably correspond to deep and shallow levels, have identical activation energies. Meanwhile, we have discovered a universal linear relationship between the inverse of the capacitance and time. An Arrhenius plot of the slope of the reciprocal of the transient yields an activation energy of approximately 0.4 eV, independent of the observation window and other experimental conditions. The reciprocal behavior leads us to hypothesize that hopping, rather than escape into high-mobility bands, may govern the transport of trapped holes in this system.

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