1. Lifetime and Doping

If the number of minority carriers is increased above that at equilibrium by some transient external excitation (such as incident sun), the excess minority carriers will decay back to that equilibrium carrier concentration due through the process of recombination. Furthermore, we have a recombination rate that depends on the number of excess minority carriers. If for example, there are no excess minority carriers, then the recombination rate must be zero. Two parameters that are integral to recombination rate are the minority carrier lifetime and the minority carrier diffusion length.

\[ \tau = \frac{\Delta n}{R} \]

\[ \frac{1}{\tau_{total}} = \frac{1}{\tau_{radiation}} + \frac{1}{\tau_{Auger}} + \frac{1}{\tau_{trap}} \]

- For doping less than \(10^{17} \text{ cm}^{-3}\) (normal for most Silicon devices) radiative combination plays a negligible role and carrier lifetime is predominantly determined by the impurity level.
- At doping levels greater than \(10^{18} \text{ cm}^{-3}\), Auger recombination becomes dominant.

http://www.pveducation.org/pvcdrom/p...ction/lifetime

References