

High temperature dependence of charge carrier properties in CVD diamond

Synthetic diamond is well suited in particle detector applications for its high radiation tolerance and fast carrier mobility. It is possible to operate a diamond detector at high temperature expected in extremely harsh radiation environments like future high luminosity beams and reactors. Therefore it is necessary to characterize and understand its electronic properties at high temperature. Several competing effects are expected to modify the charge collection efficiency and carrier mobilities in diamond. Deep levels in the band gap can act as trapping centers when the carrier density is high (important when intense radiation energy is deposited), and as generation centers when thermal excitations are enhanced at high temperature. Shallow levels in the band gap can affect carrier mobility and signal rise time through frequent trapping and de-trapping of carriers. We present signal time profile measurements using the TCT technique and charge collection efficiency from MIP energy deposition in high purity single crystal CVD diamond at high temperature. These can be used to resolve the role of traps in the bandgap of diamond and understand its electronic properties at high temperature.

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