Muon track induced current measurements in semi-insulating GaAs

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RF $\mu$SR experiments in electric fields have revealed a metastable behavior of commercial semi-insulating GaAs samples. After the treatment of the sample with strong ($|E| > 10$ kV/cm) electric field at $T = 70$ K for at least one hour, the diamagnetic RF amplitude at $T \sim 100 - 140$ K becomes two times bigger than in the "virgin" sample. Sample can be returned to the original state by raising the temperature to 250 K. Big diamagnetic fraction can be explained by two mechanisms: $\mu_T$ captures an excess electron and forms $\mu^-$, or $\mu_T$ captures an excess hole and forms $\mu^+$. To make a conclusion on the nature (electrons vs holes) of the non-equilibrium charges transport in the metastable GaAs we have performed muon track induced current measurements in the asymmetric geometry: electron–hole pairs were generated close to the incoming electrode. In this case the path for electrons and holes to the appropriate electrode is different and, by choosing the polarity of applied electric field, one can distinguish between electrons and holes currents. From Fig. 1 it is clear that in the metastable state the conductivity is switched from n to p-type or the holes are responsible for the enhanced diamagnetic asymmetry.