Shallow acceptor impurities in diamond-like semiconductors studied by polarized negative muons

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The results of μSR study of shallow acceptor centers behavior in diamond, silicon and germanium are presented. The polarization of negative muons was studied in transverse magnetic field of 1.5–2.5 kOe in the temperature range of 0.23–300 K. It was found that muonic atom, which imitates acceptor impurity in semiconductors, formed in paramagnetic state in silicon and germanium at low temperatures, whereas in synthetic diamond it is formed in diamagnetic (ionized) state.

For the first time the hyperfine interaction constant was estimated for aluminium acceptor center (AC) in silicon. The temperature and impurity concentration dependence of the AC relaxation in silicon were studied. It was shown that the main contribution to the relaxation of magnetic moment of AC is due to interaction of AC with phonon due Roman process in nondegenarated silicon at temperatures less 50 K. In case of germanium there is an experimental evidence of changing contribution of different phonon processes to the relaxation of the AC at temperature ∼10 K (see fig. 1.). The hole capture rate by ionized boron acceptor in diamond was determined.

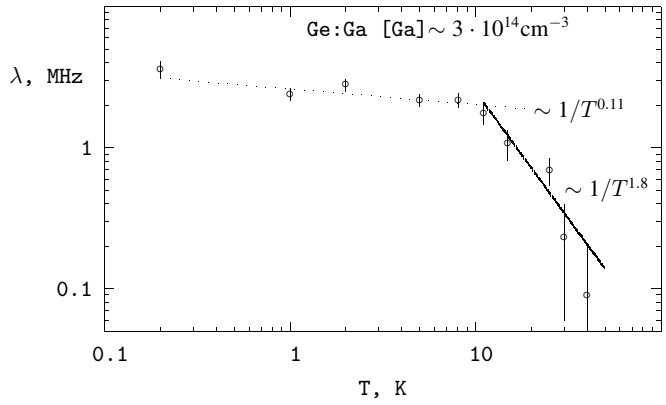

Fig. 1: The muon spin relaxation rate in germanium doped with Ga as a function of temperature