Low Energy Muon studies of semiconductor interfaces

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Previous low-energy μSR studies [1] revealed a general tendency: by lowering the energy of muons the diamagnetic fraction in semiconductors is increased. This effect can be produced by mechanisms: 1) by lowering the energy the number of track-induced electron-holes pairs is decreased and the probability of muonium formation is suppressed, 2) electrons stop closer to the surface and the number of electrons available for muonium formation is reduced due to the very effective channel of the surface recombination. To check these possibilities we performed low energy μSR experiments close to the metal-insulator interface of semi-insulating (SI) GaAs and deposited via molecular-beam epitaxy (MBE) 100 nm of heavily doped films of n and p-type GaAs.

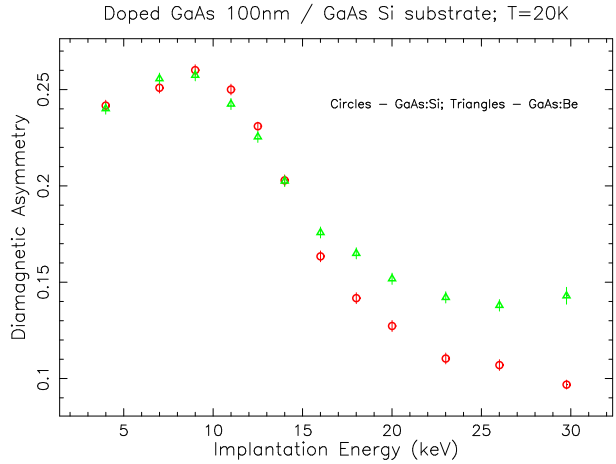

Fig. 1: Comparison of the energy dependences of the diamagnetic asymmetry in p-GaAs/SI-GaAs and n-GaAs/SI-GaAs bilayers.

For p-GaAs on SI-GaAs, track electrons from the substrate can diffuse to the interface and recombine with holes from the p-GaAs and muonium formation is reduced. This finding confirmes thar the surface/interface processes are important for the interpretation of the LEM data.

[1] T. Prokscha et al., Phys. Rev. Lett. 98 (2007) 227401.