Influence of spin polarisation on resistivity of a two-dimensional electron gas in Si MOSFET at metallic densities

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Positive magnetoresistance (PMR) of a silicon MOSFET in parallel magnetic fields B has been measured at high electron densities $n \gg n_{\rm c}$ where $n_{\rm c}$ is the critical density of the metal-insulator transition (MIT). It turns out that the normalised PMR curves, $R(B)/R(0)$, merge together when the field is scaled according to $B/B_{\rm c}(n)$ where $B_{\rm c}$ is the field in which electrons become fully spin polarised. The values of $B_{\rm c}$ in Fig. 1 have been calculated from the simple equality between the Zeeman splitting energy and the Fermi energy taking into account the experimentally measured dependence of the spin susceptibility on the electron density. This extends the range of validity of the scaling all the way to a deeply metallic regime far away from MIT. The subsequent analysis of PMR for low $n \gtrsim n_{\rm c}$ demonstrated that the merging of the initial parts of curves can bee achieved only with taking into account the temperature dependence of $B_{\rm c}$ (hence introducing a renormalised value, B_c^*, in Fig. 1). It is also shown that the shape of the PMR curves at strong magnetic fields is affected by a crossover from a purely two-dimensional (2D) electron transport to a regime where out-of-plane carrier motion becomes important (quasi-three-dimensional regime)[1].

[1] I. Shlimak *et al.*, Europhys. Lett. **97**, 37002 (2012).

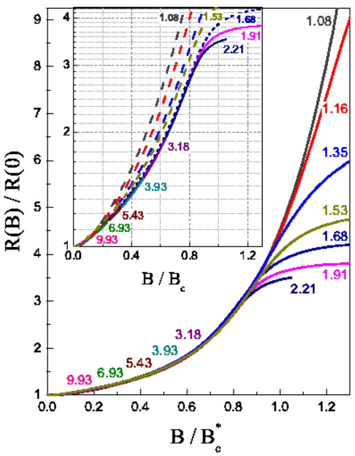

Figure 1: Normalised magnetoresistance $R(B)/R(0)$ scaled as a function of $B/B_{\rm c}$ (inset) and as a function of $B/B_{\rm c}^*$ (main panel). Values of n are in units of $10^{11}{\rm cm}^{-2}$; for $n \geq 2.21{\rm cm}^{-2}$, the position of each value marks the end of the corresponding curve.