METAL-INSULATOR TRANSITION IN Si/SiGe HETEROSTRUCTURES

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Introduction

Magnetoresistance and Hall resistance of a two dimensional hole gas have been studied on CVD grown boron doped Si/Si$_{0.87}$Ge$_{0.13}$ heterostructures in magnetic fields of up to 18T and temperature range 0.3 – 10K.

Experiment and Results

Two samples with different boron concentration had the Hall bars configuration and had been prepared by convenient silicon processing technology. Magnetotransport measurements have been performed in magnetic field perpendicular to the two dimensional layer containing the hole gas. Quantum oscillations and quantum Hall effect have been observed on the longitudinal (Fig. 1 (a)) and transverse (Fig. 1 (b)) magnetoresistance curves, respectively.

The measurements revealed hole concentrations of 2.1⋅10$^{11}$ and 1.1⋅10$^{12}$ cm$^{-2}$, effective masses of 0.29 (Fig. 1. (c)) and 0.31m$_{e}$ and Hall mobility 1⋅10$^{3}$ and 4⋅10$^{3}$, respectively for samples #1 and #2. The most interesting behavior was observed at temperatures below 2K on sample #1 in the high magnetic field range where filling factor $\nu < 1$ and sample is in the ultra quantum limit. In fields above 12T longitudinal resistance of the sample #1 rises up and the I-V curve shows a threshold behavior [Fig. 1 (d)]. Such features are usually associated with a metal-insulator transition of two dimensional systems [1]. Further investigation has to be performed to distinguish the nature of the insulating phase formation.

![Figure 1](image)

Figure 1. Field dependence of longitudinal resistance (a) and transverse resistance (b) both at various temperatures; effective mass determination from the temperature dependence of the quantum oscillation amplitude (c); I-V curve at 18T (d); all for sample #1.

References