Transport of dilute MgZnO/ZnO heterostructures

Falson, J., Tabrea, D. and Smet, J.H. (Max Planck Institute, Stuttgart, Germany)

Introduction

The MgZnO/ZnO heterostructure hosts a high mobility two-dimensional electron system (2DES) at its heterointerface which shows a maximum mobility exceeding 1 x 10^6 cm^2/Vs. The carriers at low temperature and high magnetic field elicit unique facets of correlated electron physics, including rich fractional quantum Hall features [1,2].

Experimental

In this work, we have measured ultra-dilute heterostructures with charge density n ~ 1.9 x 10^{10} cm^{-2}. The magnetotransport is shown in Fig. 1, as taken in Bay 3 of the High *B*/*T* facility at the University of Florida. The preliminary results confirm that even the most dilute samples available remain metallic down to ultra-low T < 1 mK, and display robust integer quantum Hall physics.

Results and Discussion

A number of features can be identified in the magnetotransport. Firstly, a steady increase in resistance was observed from zero *B*-field to B ~ 0.15 T, which is likely associated with the full spin polarization of the 2DES. Beyond this *B*-field, the integer quantum Hall effect begins to develop, with minima observed at ν = 4, 3, 2 and 1. This spacing suggests the spin degeneracy of electrons is lifted and each of the states is fully spin polarized. Finally, a large peak in resistance is observed between ν = 2 and 1, where the longitudinal resistance rises to over $10h/e^2$. This feature may be associated with a reentrant insulating state, as previously identified in GaAs 2DES [3], but requires further study to understand its underlying nature.

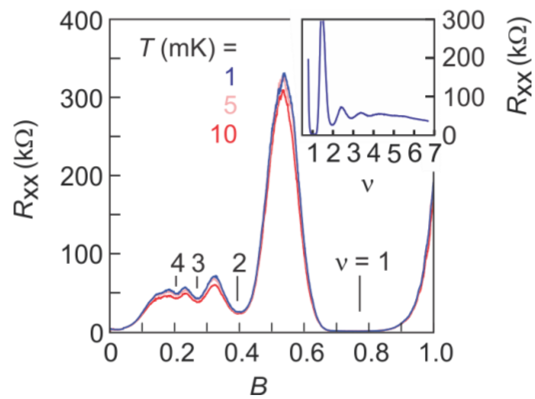

Fig.1 Temperature dependent (T = 1, 5 and 10 mK) magnetotransport of a dilute MgZnO/ZnO heterostructure. Robust integer quantum Hall features are observed. Inset: Magnetoresistance as a function of filling factor (ν). Integer steps between 1 and 4 suggest all levels are spin resolved.

Conclusions

The verification of metallicity of dilute MgZnO/ZnO samples suggests them as a novel platform to study strongly interacting carriers in the context of quantum criticality. Future studies will incorporate more sophisticated measurement techniques, such as gated heterostructures and sample rotation to investigate charge density dependence and spin polarization of ground states.

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References

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