Quantum Hall Effect in Chemically Functionalized Graphene: Defect-Induced Critical States and Breakdown of Electron-Hole Symmetry

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Unconventional magneto-transport fingerprints in the quantum Hall regime (with applied magnetic field from one to several tens of Tesla) in chemically functionalized graphene are reported [1]. The scattering potential induced by the impurities is modeled by tight-binding parameters extracted from *ab initio* calculations [2], which, in turn, are used inside an efficient real space order *N* method [3] to calculate the dissipative conductivity [4] under high field. Upon chemical adsorption of monoatomic oxygen (from 0.5% to few percents), the electron-hole symmetry of Landau levels is broken, while a double-peaked conductivity develops at low-energy, resulting from the formation of critical states conveyed by the random network of defects-induced impurity states. Scaling analysis suggests an additional zero-energy quantized Hall conductance plateau, which is here not connected to degeneracy lifting of Landau levels by sublattice symmetry breakage. This singularly contrasts with usual interpretation, and unveils a new playground for tailoring the fundamental characteristics of the quantum Hall effect.

References

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Figures