HL 90: Graphene: Transport incl. Spin Physics and Magnetic Fields II

Time: Thursday 17:00–18:30 Location: ER 270

HL 90.1 Thu 17:00 ER 270

Launching surface plasmons on a metal/dielectric interface by emission from graphene — •Matthias Handloser[1], Sebastian Böcklein[1], Jürgen Kraus[2], Sebastian Günther[2], and Achim Hartschuh[1] — [1]Department Chemie und CeNS, LMU, München, Germany — [2]Department Chemie, TUM, München, Germany

Graphene could eventually play an important role in photonics and optoelectronics due to its particular physical properties. We report on the excitation of propagating surface plasmons in thin metal films launched by photoexcited graphene. Graphene was deposited on a thin dielectric spacer layer on top of a thin metal film. Broadband non- linear photoluminescence (PL) of graphene [1,2] created by femtosecond pulsed excitation at 800 nm launches surface plasmons that are detected via leakage radiation microscopy [3]. Coupling to plasmons almost completely reshapes the emission both spatially and with respect to polarization as compared to graphene on a dielectric substrate. The angular dependence of plasmon coupled emission is used to map the dispersion relation of surface plasmons from 450-1000 nm. We further investigate the role of local defects and graphene edges on the emission characteristics. [1] R.J. Stöhr, et. al., Phys. Rev. B 82, 121408(R) (2010) [2] W-T Liu, et. al., Phys. Rev. B 82, 081408(R) (2010) [3] B. Hecht, et.al., Phys. Rev. Lett. 77,1889 (1996)

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Does contact induced doping limit the measurable spin dephasing time in graphene non-local spin valves? — •Marc Drögeler[1,2], Frieder Reichenzer[1,2], Stefan Göbbels[1,2], Frank Volmer[1,2], Eva Maynicke[1,2], Gernot Güntherodt[1,2], and Bernd Beschoten[1,2] — [1]II. Institute of Physics, RWTH Aachen University, 52074 Aachen — [2]JARA: Fundamentals of Future Information Technology, 52074 Aachen

With respect to spintronics, graphene has the advantage to consist of light atoms and, thus, exhibits negligible spin-orbit coupling and hyperfine interaction in isotopically pure material. This leads to long spin dephasing times with values predicted in the range of μs. The first spin transport measurements, however, revealed spin dephasing times in the range of a few hundred ps. In the meantime, values of 6.2 ns at 20 K [1] and 1.9 ns at room temperature [2] have been reported, which are still far below predicted values. A possible source of spin dephasing may arise from contact-induced carrier doping and consequential local electric fields in the graphene sheet. Here we use photo-current measurements to determine the contact induced doping in graphene-based non-local spin valves, which may be correlated to spin dephasing times as extracted from conventional Hanle spin precession measurements. Furthermore, we investigate the dependence of the photo-current on the polarization angle and helicity of the light.

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[1] Han *et al.* Phys. Rev. Lett. 107, 047207 (2011).
[2] Yang *et al.* Phys. Rev. Lett. 107, 047206 (2011).

HL 90.3 Thu 17:30 ER 270

Graphene Field-Effect Transistors on Hexagonal Boron Nitride Operating at Microwave Frequencies — •Christian Benz[1,4], Emiliano Pallecchi[2], Andreas C. Betz[2], Kenji Watanabe[3], Takashi Taniguchi[3], Hilbert v. Löhneysen[1,4], Bernard Plaçais[2], and Romain Danneau[1,4] — [1]Institute of Nanotechnology, Karlsruhe Institute of Technology (KIT), Germany — [2]Laboratoire Pierre Aigrain, Ecole Normale Supérieure, Paris, France — [3]National Institute for Materials Science, 1-1 Namiki, Tsukuba, 305-0044, Japan — [4]Physikalisches Institut, KIT, Germany

Due to the high charge carrier mobility in graphene, it is an ideal candidate for devices operating at microwave frequency. We have investigated RF graphene field-effect transistors (GFETs) on hexagonal boron nitride. Atomically flat boron nitride crystals are known to increase the mobility by reducing scattering in the graphene. At the same time, the boron nitride serves the purpose of dielectric between graphene sheet and prepatterned gate electrode. Thus, a minimum of charge impurities is introduced to the graphene and current annealing remains possible since the graphene channel is not covered by an oxide. Our GFETs were prepared from exfoliated mono- and bi-layer graphene with a subsequent dry transfer technique onto sapphire, a fully insulating substrate. To improve the flatness, we employed an all-graphene layout with graphene gate fingers. Several devices with gate lengths down to 100 nm were produced and measured. Our GFETs allow for integration into circuits like amplifiers or mixers and are well suited for cryogenic applications.

HL 90.4 Thu 17:45 ER 270

Influence of indium contacts on electronic transport in graphene — •Felix Nippert, Harald Scheel, Janina Maultzsch, and Christian Thomsen — Insititut für Festkörperphysik, Technische Universität Berlin

We study the influence of micro-soldered indium contacts on electronic transport in graphene. In four point transport measurements using a variable back gate voltage V_G we observe a strong electron-hole-asymmetry that is associated with a Fermi energy shift in the vicinity of the contacts. This is due to n-type doping caused by differing work functions of graphene and indium. We propose a simple analytical model based on different mobilities for electrons and holes and a standard distribution of the Fermi level position to explain this asymmetry and the observed minimum conductivity.

We notice an additional resistance on the hole side, which we associate with a graphene pn-junction that arises when the bulk graphene is p-type while the region influenced by the contacts is still n-type. We compare our results with similar measurements in the literature involving other contact metals and show that they support our model.

HL 90.5 Thu 18:00 ER 270

Length dependence of the resistance in graphite: influence of ballistic transport — •Pablo Esquinazi[1], Jose Barzola-Quiquia[1], Srujana Dusari[1], and Nicolas Garcia[2] — [1]Division of Superconductivity and Magnetism, Institut für Experimentelle Physik II, Universität Leipzig, Linnéstraße 5, D-04103 Leipzig, Germany — [2]Laboratorio de Física de Sistemas Pequeños y Nanotecnología, Consejo Superior de Investigaciones Científicas, E-28006 Madrid, Spain

Using a linear array of voltage electrodes with a separation of several micrometers on a 20 nm thick and 30 μm long multigraphene sample we show that the measured resistance does not follow the usual length dependence according to Ohm's law. The deviations can be quantitatively explained taking into account Sharvin-Knudsen formula for ballistic transport. This allows us to obtain without free parameters the mean free path of the carriers in the sample at different temperatures. In agreement with recently reported values obtained with a different experimental method, we obtain that the carrier mean free path is of the order of ~ 2 μm with a mobility $\mu \sim 10^7$ cm^{2}V^{-1}s^{-1}. The results indicate that the usual Ohm's law is not adequate to calculate the absolute resistivity of mesoscopic graphite samples.

HL 90.6 Thu 18:15 ER 270

solution-based fabrication of thin film transistors with single-walled carbon nanotube — •alireza mousavi[1,2], veit wagner[1], vincenzo tucci[2], patrizia lamberti[2], and jürgen fritz[1] — [1]jacobs university bremen — [2]university of salerno

Thin film of single-walled Carbon nanotubes (SWCNTs) offers great promise for a variety of application due to exceptional electrical and mechanical properties. The ability to tune SWCNTs topology is crucial for fabrication of SWCNT-thin film transistors (TFTs). Thin films of SWCNTs network represent a promising track to scalable device manufacturing and to fabricate devices at low temperatures. Insolubility of the CNTs in most solvents and mixture of semiconducting and metallic CNTs are major challenges towards real application. To improve solubility while preserving the properties of SWCNTs are needed for low-cost and industry feasible approaches. In this paper, two methods, vacuum filtration and dielectrophoresis, based on different solvents are compared. As solvents, aqueous solution of sodium dodecylbenzene sulfonate, SDBS, as surfactant and N-Methyl-2-pyrrolidone, NMP, are used to disperse CNTs noncovalently by help of sonication. The devices preparation, Au electrodes with various channel lengths are patterned on silicon wafers. Subsequently, the surface is treated with Amine terminated self-assembled monolayers to selectively adsorb carbon nanotube. All approaches showed promising results, e.g. mobility of 0.3 cm2/Vs was found for vacuum filtration and CNTs dissolved in SDBS. Moreover, it will be shown how quantitatively the metallic part of SWCNT is contributed to the output performance of device.