

MM 21: Transport - Ions and Electrons

Time: Tuesday 10:15–11:30

Location: IFW B

MM 21.1 Tue 10:15 IFW B

Site energy distribution of sodium ions in a sodium rubidium borate glass — ●MARTIN SCHÄFER, DAVID BUDINA, and KARL-MICHAEL WEITZEL — Universität Marburg, Fachbereich Chemie

A charge attachment induced transport experiment [1] has been conducted on a Na^+ and Rb^+ containing glass employing an external Rb^+ ion beam. Native Na^+ ions are replaced by external Rb^+ ions giving rise to a pronounced concentration depth profile as measured by time-of-flight secondary ion mass spectrometry. From the theoretical analysis of this concentration profile a unique site energy distribution (SED) of mobile Na^+ ions in the glass is derived [2]. The full width at half maximum of the populated part of this SED is 0.32 eV. The mechanism involves Na^+ sites being vacated top-down and being filled by Rb^+ also top down. Therefore, the Fermi energy of Na^+ ions decreases with ongoing experiment, while that of the Rb^+ ions stays constant. Agreement between experiment and the Nernst-Planck-Poisson theory for describing the transport is reached by assuming that both the migration and the chemical diffusion driven contribution to the total flux depend on the local concentration. [1] M. Schäfer, K.-M. Weitzel, *Materials Today Physics*, 5, 12-19, (2018). [2] M. Schäfer, D. Budina, K.-M. Weitzel, *Phys. Chem. Chem. Phys.* in press (2019).

MM 21.2 Tue 10:30 IFW B

Quantum Paracrystalline Shear Modes in Metals — ●JUN YONG KHOO¹, FALKO PIENKA¹, PO-YAO CHANG^{1,2}, and INTI SODEMANN¹ — ¹Max-Planck Institute for the Physics of Complex Systems, D-01187 Dresden, Germany — ²Department of Physics, National Tsing Hua University, Hsinchu 30013, Taiwan

Unlike classical fluids, a quantum Fermi liquid can support a long-lived and propagating shear sound wave, reminiscent of the transverse sound in crystals, despite lacking any form of long-range crystalline order. This mode is expected to be present in moderately interacting metals where the quasiparticle mass is renormalised to be more than twice the bare mass, but, it is hard to excite and detect because it does not involve charge density fluctuations, in contrast to the conventional plasma mode. In this work we propose a strategy to excite and detect this unconventional mode in clean metallic channels. We show that the shear sound is responsible for the appearance of sharp dips in the AC conductance of narrow channels at frequencies matching the shear sound dispersion. The liquid resonates while minimizing its dissipation, a behavior characteristic of the sliding crystal. Ultra-clean 2D materials such as graphene, PdCoO_2 , and MgZnO/ZnO 2DEGs are therefore particularly promising platforms to discover the shear sound.

MM 21.3 Tue 10:45 IFW B

Curve graphene systems to create new Hall-like effects in zero magnetic field — ●CHING-HAO CHANG^{1,2}, SHENG-CHIN HO¹, YU-CHIANG HSIEH¹, SHUN-TSUNG LO¹, BOTSZ HUANG¹, THI-HAI-YEN VU¹, CARMINE ORTIX^{3,4}, and TSE-MING CHEN^{1,2} — ¹Department of Physics, National Cheng Kung University, Tainan 701, Taiwan — ²Center for Quantum Frontiers of Research & Technology (QFort), National Cheng Kung University, Tainan 701, Taiwan — ³Institute for Theoretical Physics, Center for Extreme Matter and Emergent Phenomena, Utrecht University, Princetonplein 5, NL-3584 CC Utrecht, Netherlands — ⁴Dipartimento di Fisica E. R. Caianiello, Università Salerno, IT-84084 Fisciano, Italy

In this talk, I will show that Hall-like effects can be created in graphene systems by using curved geometry instead of applying an external magnetic field. We theoretically establish that non-trivial band struc-

ture with valley-orbital splitting can be designed in a bilayer graphene (BLG) by corrugating it. This band structure finally generates the transverse resistivity in both linear response and nonlinear response regimes. Our theoretical calculations well address experimental observations qualitatively and quantitatively. This new approach based on tailoring 2D-material geometry opens a new platform to design the band structure to host new transport properties.

MM 21.4 Tue 11:00 IFW B

Quantitative analysis of non-radiative relaxation processes in luminescent borate glass by infrared thermography —

●NILS J. ZIEGELER¹, PETER W. NOLTE², and STEFAN SCHWEIZER^{1,2} — ¹Department of Electrical Engineering, South Westphalia University of Applied Sciences, Lübecker Ring 2, 59494 Soest, Germany — ²Fraunhofer Application Center for Inorganic Phosphors, Branch Lab of Fraunhofer Institute for Microstructure of Materials and Systems IMWS, Lübecker Ring 2, 59494 Soest, Germany

Lanthanide-doped borate glasses represent an interesting class of luminescent materials. Though these systems offer high photoluminescence quantum efficiency (QE) values, a significant part of the excitation power is converted to heat due to unavoidable non-radiative relaxation processes. In this contribution, the amount of generated heat is estimated from infrared thermography investigations. For this, the glass sample's surface temperature is monitored under continuous optical excitation. To obtain the volumetric heat rate, the spatially resolved temperature data are analysed on the basis of the partial differential heat equation. Experiments on barium borate glass with different lanthanide doping concentrations are performed. A comparison with optical measurements shows that the approach to determine the QE indirectly by estimating the amount of non-radiative relaxation processes is very promising and particularly interesting for QE measurements at high temperatures.

MM 21.5 Tue 11:15 IFW B

Investigation of the universal scattering rate in PdCrO_2 by high energy electron irradiation — ●ELINA ZHAKINA^{1,3}, PHILIPPA MCGUINNESS^{1,3}, SEUNGHYUN KHMIM¹, VERONIKA SUNKO¹, ANDREW MACKENZIE^{1,3}, and MARCIN KONCZYKOWSKI² — ¹Max Planck Institute for Chemical physics of solids, Dresden, Germany — ²Laboratoire des Solides Irradiés, Ecole Polytechnique, Palaiseau, France — ³School of Physics and Astronomy University of St Andrews, North Haugh St Andrews, Scotland

PdCrO_2 belongs to the delafossite family of extremely pure triangular lattice metals. The CrO_2 layers are Mott insulating, and order antiferromagnetically below 37.5K. The resistivity of PdCrO_2 is linear in temperature above 150 K. This is in contrast to the non-magnetic sister compound PdCoO_2 , indicating that it is a consequence of the coupling to the Mott-insulating layer. Intriguingly, in the region of the T-linear resistivity, the scattering rate per kelvin is well approximated by the ratio of fundamental constants, k_B/h . Numerous other materials reveal the same slope in the T-linear region, in spite of large differences in the microscopic origins of the scattering. To investigate the universal behaviour of the scattering rate, we conducted a systematic study of the influence of point defects on the resistivity of PdCrO_2 , the results of which we report here. We introduced point defects to microstructures of PdCrO_2 by irradiating them with high-energy electrons. Comparing the results with those on PdCoO_2 , we confirm that the increase in the resistivity is dominated by point defects in conductive Pd layers.