DS 10: Transport Properties

Time: Thursday 11:30–12:30 Location: H14

DS 10.1 Thu 11:30 H14

A tunable room temperature nonlinear Hall effect in elemental bismuth thin films — •Pavlo Makushko[1], Sergey Kovalev[1], Yevhen Zabila[1], Igor Ilyakov[1], Alexey Ponomaryov[1], Atiqa Arshad[1], Gulloo Lal Prajapati[1], Thales V. A. G. de Oliveira[1], Jan-Christoph Deinert[1], Paul Chekhonin[1], Igor Veremchuk[1], Tobias Kosub[1], Yurii Skourski[1], Fabian Ganss[1], Denys Makarov[1], and Carmine Ortix[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V. — [2]Università di Salerno, Fisciano (SA), Italy

The nonlinear Hall effect with time-reversal symmetry is a second-order electronic transport phenomenon that induces frequency doubling and occurs in non-centrosymmetric crystals with Berry curvature dipole. This effect was typically reported in complex compounds characterized by Dirac or Weyl electrons at low temperatures. Here, we report a room temperature nonlinear Hall effect in polycrystalline thin films of the centrosymmetric elemental bismuth. The nonlinear transversal currents are induced by electrons at the (111) free surface, which possesses a Berry curvature triple. The nonlinear transverse voltage can be boosted by the geometric nonlinear Hall effect in arc-shaped bismuth stripes. The geometric curvature induced frequency doubling is extended to the second-harmonic generation in the terahertz spectral range. We also demonstrate efficient high-harmonic generation in polycrystalline bismuth films and bismuth-based heterostructures across a broad range of terahertz frequencies.

[1] P. Makushko et al., Nature Electronics 7, 207 (2024).

DS 10.2 Thu 11:45 H14

Electrochemical characterization of CeO_2/YSZ multilayer systems with well-defined interfaces — •Julius K. Dinter[1], Anja Henss[1,2], and Matthias T. Elm[1,2] — [1]ZfM, JLU Gießen — [2]Institute of Experimental Physics, JLU Gießen

Mixed ionic and electronic conductors (MIECs) are key components for a variety of electrochemical devices. Their functionality depends on their ability to store or transport both electrons and ions. However, most materials with high ionic conductivity exhibit poor electronic conductivity and vice versa. A common approach to overcome this challenge is the preparation of artificial mixed conductors by mechanically mixing a good electronic conductor with an ionic conductor. Consequently, these artificial MIECs are characterized by a high number of interfaces, which can significantly affect charge storage and charge transport in the composites. A detailed understanding of the impact of these interfaces on the electrochemical properties is essential for the design and improvement of electrochemical devices with enhanced functionality. We present the preparation and characterization of multilayer heterostructures of ceria (CeO_2) and yttria-stabilized zirconia (YSZ). The multilayers with constant thickness but varying number of interfaces were prepared by pulsed laser deposition to obtain thin film structures with well-defined interfaces. Structural characterization was performed using Raman microscopy and time-of-flight secondary ion mass spectrometry. The electrochemical properties were characterized by electrochemical impedance spectroscopy at different temperatures and under varying atmospheric conditions.

DS 10.3 Thu 12:00 H14

Magneto transport in bilayer graphene cavities — •Florian Schöppl[1], Michael Barth[1], Ming-Hao Liu[2], Klaus Richter[1], and Angelika Knothe[1] — [1]Institut für Theoretische Physik, 93053 Regensburg, Germany — [2]Department of Physics, National Cheng Kung University, Tainan City 701, Taiwan

The remarkable sample quality of bilayer graphene in combination with the unprecedented electronic control of the band-structure makes bilayer-graphene an excellent platform for electron optics. While the purity of the system allows for ballistic transport on the micrometer scales [1,2], the trigonal warping of the band structure close to each K points induces a valley dependent selection of momenta leading to unique transport and scattering properties [3,4]. Interested in the interplay of symmetry breaking induced by a variety of all-electronic gate confinements and the trigonal warping, we implement various quantum mechanical tight binding models as well as semiclassical simulations and deploy them to investigate magneto transport through bilayer graphene cavities.

[1]L. Seemann et al., Gate-tunable regular and chaotic electron dynamics in ballistic bilayer graphene cavities, Phys.Rev. B (2023) [2]L. Banszerus et al., Ballistic Transport Exceeding 28*m in CVD Grown Graphene, Nano Lett. 2016 [3]C. Gold et al., Coherent Jetting behind a gate-defined channel in bilayer graphene, Phys.Rev. Lett. (2021) [4]J.K. Schrepfer e t al. Dirac fermion optics and directed emession from single- and bilayer graphene cavities, Phys. Rev. B (2021)

DS 10.4 Thu 12:15 H14

Electrical transport across thin catalyst/defect-engineered titania corrosion protection layer interfaces for photoelectrochemical applications — •Julius Kühne[1,2], Tim Rieth[1,2], and Ian D. Sharp[1,2] — [1]Walter Schottky Institute, Technichal University of Munich, Am Coulombwall 4, 85748 Garching, Germany — [2]Physics Department, TUM School of Natural Sciences, Technical University of Munich, Am Coulombwall 4, 85748 Garching, Germany

Producing value-added products via light-driven photoreduction represents a promising approach to sustainably address increasing CO2 emissions and meet the growing global energy demand. However, such solar fuels systems require passivating layers to chemically protect semiconductor light absorbers from harsh reaction environments. Despite great progress in the development of atomic layer deposited (ALD) protection layers, the factors governing efficient charge injection into the catalytic component remain not well understood. The nanoscale thickness of these ultrathin layers presents unique challenges, particularly for in-plane electrical measurements, complicating the reliable characterization of their transport properties compared to bulk materials. Here, the charge transport characteristics between various defect-engineered TiO2 protection layers grown with ALD and metal catalyst layers are investigated. By analyzing contact resistivity, carrier transport, and interface kinetics, this work seeks to deepen understanding of the interface between catalyst and protection layer.