DS 25: Transport Properties

Time: Thursday 15:00–16:00 Location: H14

DS 25.1 Thu 15:00 H14

Visualization of metallic filament formation in rare-earth nickelates via optical microscopy — •Theodor Luibrand[1], Stefan Guénon[1], Farnaz Tahouni-Bonab[1], Javier del Valle[2], Claribel Domínguez[2], Willem Rischau[2], Lucia Varbaro[2], Stefano Gariglio[2], Rodolfo Rocco[3], Soumen Bag[3], Marcelo Rozenberg[3], Jean-Marc Triscone[2], Reinhold Kleiner[1], and Dieter Koelle[1] — [1]Physikalisches Institut, Center for Quantum Science (CQ) an LISA$^+$, Universität Tübingen, 72076 Tübingen, Germany — [2]Department of Quantum Matter Physics, Université de Genève, 1211 Geneva, Switzerland — [3]Université Paris-Saclay, CNRS, Laboratoire de Physique des Solides, 91405 Orsay, France

In recent years, there has been growing interest in resistive switching in strongly correlated materials. Resistive switching is at the core of memristive devices, which are considered as crucial elements in the emerging field of neuromorphic computing. However, in many systems, the details of the resistive switching mechanisms are elusive. We investigated the resistive switching of two types of rare-earth nickelate ($NdNiO_3$ and $SmNiO_3$) thin film devices. Both materials undergo insulator-to-metal transitions (IMT) from low-temperature antiferromagnetic or paramagnetic insulating to high-temperature paramagnetic metallic phases. Current-voltage characteristics acquired at device temperatures near the IMT show jumps towards lower voltages indicating resistive switching. We find that these events are accompanied by the formation of spatially confined conducting filaments, which is revealed by a change in reflectivity in optical images.

DS 25.2 Thu 15:15 H14

Towards ultraclean correlated metal $CaVO_3$ - Electric Transport Measurements — •Mahni Müller[1], Tatiana Kuznetsova[2], Roman Engel-Herbert[2,3], and Saskia F. Fischer[1] — [1]Novel Materials Group, HU Berlin, 10099 Berlin, Germany — [2]Department of Materials Science and Engineering, The Pennsylvania State University, University Park, PA 16802, USA. — [3]Paul-Drude-Institut für Festkörperelektronik, 10117 Berlin, Germany

High-performance and cost-effective transparent materials are in great demand in the optoelectronic industry. The enhancement of the carrier effective mass through strong electron-electron interactions in correlated metals is a promising approach to achieve both high-optical transparency and high-electrical conductivity [1].

In this work we study the electric transport characteristics of $CaVO_3$ films with a thickness of 55 nm grown on LAO substrates. The films were deposited by hybrid molecular beam epitaxy with different partial pressures of the metalorganic vanadium oxytriisopropoxide precursor. Calcium was supplied through a solid state effusion cell. The optimal growth window estimated by X-ray diffraction was narrowed down by residual-resistance ratio (*RRR*) measurements. Temperature dependent resistivity and hall measurements were performed between 4.2 K and 300 K. The *RRR* was tripled compared to previous substrate [2]. Furthermore, the films with highest $RRR \approx 98$ showed an increase of mobility with decreasing temperature with over 2000 $\frac{\mathrm{cm}}{\mathrm{V \cdot s}}$ at 4.2 K.

[1] Zhang, Lei, *et al.*; Nature materials **15.2**, 204-210 (2016).
[2] Eaton, Craig, *et al.*; J. Vac. Sci. Technol. **35.6**, 061510, (2017).

DS 25.3 Thu 15:30 H14

Electro-Thermal Resistive Switching at the Insulator to Metal Transition in Strongly Correlated Materials — •Stefan Guénon[1], Matthias Lange[1], Yoav Kalcheim[2,3], Theodor Luibrand[1], Farnaz Tahouni[1], Reinhold Kleiner[1], Ivan K Schuller[2], and Dieter Koelle[1] — [1]Physikalisches Institut, Center for Quantum Science (CQ) and LISA$^+$, Universität Tübingen, 72076 Tübingen, Germany — [2]Department of Physics and Center for Advanced Nanoscience, University of California - San Diego La Jolla, CA 92093, USA — [3]Department of Materials Science and Engineering, Technion - Israel Institute of Technology, Technion City, 32000 Haifa, Israel

Electro-thermal (Joule-heating driven) resistive switching devices are investigated in the emerging field of neuromorphic computing. In a biomimetic approach, the memristive properties of such devices are used to emulate neurons and synapses. This talk explains how the considerable resistance change at the insulator-to-metal transition leads to electro-thermal instability. A metallic filament forms above a certain threshold current due to current and temperature redistribution if a device is electrically biased in this unstable temperature regime. We will complement the explanation with experimental results from microscopic studies on V_2O_3-devices, in which photomicrographs were acquired during filament formation. Further, we will discuss how additional device properties like thermal hysteresis or structural phase separation affect electro-thermal resistive switching. The U.S. Department of Energy supported this work under Award # DE-SC0019273.

DS 25.4 Thu 15:45 H14

Parallel field magnetoconductance in epitaxial bismuth quantum films — •Julian Koch[1], Doaa Abdelbarey[2], Philipp Kröger[2], Priyanka Yogi[2], Christoph Tegenkamp[1], and Herbert Pfnür[2] — [1]Institut für Physik, TU Chemnitz, Reichenhainerstr. 70, 09126 Chemnitz — [2]Institut für Festkörperphysik, Leibniz Universität Hannover, Appelstraße 2, 30167 Hannover

The magnetoconductance (MC) of epitaxial Bi films on Si(111) (thickness 20-100 bilayers) was measured at $T = 9$ K in magnetic fields oriented in-plane parallel and perpendicular to the electric dc current I. Contributions to MC by weak antilocalization (WAL), by weak localization (WL) as well as by diffuse scattering were identified, which all turned out to be independent of the angle between B and I. In addition, only for $B \perp I$ a contribution to MC was found that *increases* with increasing B and is, to first approximation, $\propto B^2$. It is ascribed to ballistic scattering between the Rashba-split interfaces that allow Umklapp scattering without spin flip.

At small thicknesses the MC curves are dominated by WAL originating from the surface/interface states. However, the coupling between the interfaces, necessary for the observation of WAL in an in-plane B-field, happens through quantized bulk states instead of tunneling. Moreover, the admixing of the quantized bulk states with increasing film thickness not only increases diffuse scattering, but also modifies the WAL component, effectively introducing a WL-like component, above 50 BL. Thus, our findings suggest an intriguing interplay in magnetotransport between 2D and quantized 3D states.