TT 10: Measuring Devices, Cryotechnique: Poster Session

Time: Monday 14:00–18:00 Location: Poster A

TT 10.1 Mon 14:00 Poster A

Broadband cw THz spectroscopy at low temperatures and high magnetic fields — •A. Janssen[1], K. Thirunavukkuarasu[1], H. Schmitz[1], A. Roggenbuck[1,2], A. Deninger[2], I. Cámara Mayorga[3], J. Hemberger[1], R. Güsten[3], and M. Grüninger[1] — [1]II. Physikalisches Institut, Universität zu Köln, Zülpicher Str. 77, D-50937 Köln, Germany — [2]TOPTICA Photonics AG, Lochhamer Schlag 19, D-82166 Gräfelfing, Germany — [3]Max-Planck-Institute for Radio Astronomy, Auf dem Hügel 69, D-53121 Bonn, Germany

THz spectroscopy has been of great interest lately as it reveals the low-energy electronic phenomena in several materials like high-Tc superconductors, heavy fermion compounds and more recently multiferroic materials. While in particular time-domain THz-spectroscopy meanwhile has become a common tool, we use an optical homodyne method to generate a continuous-wave (cw) THz-Signal: A photomixer is illuminated by the light of two tunable DFB IR-lasers with adjacent frequencies and emits an electromagnetic wave through a silicon lens with the difference frequency in the THz-frequency range. A wide bandwidth, high spectral resolution and frequency stability are the benefits of this technique. For investigations at low temperatures and high magnetic fields, an integrated photomixer face-to-face assembly was set up circumventing the need of intensity diminishing optical components as lenses, mirrors, or windows. We will present the development and testing of a fiber-based cw broadband THz spectrometer in the frequency range of 60 GHz to 1.8 THz for the use within conventional 4He magneto-cryostat systems.

TT 10.2 Mon 14:00 Poster A

Coherent broadband cw THz spectroscopy on solid-state samples: recent improvements — •H. Schmitz[1], A. Roggenbuck[1,2], K. Thirunavukkuarasu[1], A. Janssen[1], A. Deninger[2], I. Cámara Mayorga[3], J. Hemberger[1], R. Güsten[3], and M. Grüninger[1] — [1]II. Physikalisches Institut, Universität zu Köln, Zülpicher Str. 77, D-50937 Köln, Germany — [2]TOPTICA Photonics AG, Lochhamer Schlag 19, D-82166 Gräfelfing, Germany — [3]Max-Planck-Institute for Radio Astronomy, Auf dem Hügel 69, D-53121 Bonn, Germany

We aim at the precise determination of the complex dielectric function $\varepsilon(\omega)$ of solid state samples in the THz range. Our spectrometer employs photomixing of two NIR lasers. The photomixer efficiently converts the laser beat into THz radiation from 60 GHz to 1.8 THz. The signal is coherently detected using a second photomixer which preserves the THz phase information. In order to determine $\varepsilon(\omega)$, we either sweep the frequency in small steps ($\sim$ 30 MHz) or we modulate the phase of the laser beat. This can be achieved using a fiber stretcher which modulates faster than a mechanical delay stage. In addition, we implement a photocurrent correction to account for drifts in the THz intensity using the dc photocurrents measured at the photomixers. We demonstrate the excellent performance of the spectrometer for different solid state samples.

TT 10.3 Mon 14:00 Poster A

A 300 mK, 9 T, UHV scanning tunneling microscope — •Danny Baumann[1], Juliana Brunzlaff[1], Torben Hänke[1], Christian Hess[1], Marko Kaiser[2], Ralf Voigtländer[2], Dirk Lindackers[2], and Bernd Büchner[1] — [1]Institut für Festkörperforschung, IFW Dresden — [2]Bereich Forschungstechnik, IFW Dresden

We present the results of first measurements with a 300 mK 9 T ultra high vacuum (UHV) scanning tunneling microscope (STM). This home build STM is equipped with a coarse xy-sample positioning system, in-situ tip exchange as well as a three chamber UHV system to prepare, store and analyze samples.

Furthermore, we show the design of the new home build coarse xy-sample positioning system which is directly mounted on the STM head and works at very low temperatures, high magnetic fields and UHV conditions.

TT 10.4 Mon 14:00 Poster A

Design of a dip stick 4 K scanning tunneling microscope — •Ronny Schlegel[1], Torben Hänke[1], Danny Baumann[1], Christian Hess[1], Marko Kaiser[2], Ralf Voigtländer[2], Dirk Lindackers[2], and Bernd Büchner[1] — [1]Institut für Festkörperforschung, IFW Dresden — [2]Bereich Forschungstechnik, IFW Dresden

To study electronic and surface structures with scanning tunneling spectroscopy (STS) we designed a STM for temperatures from 300 K down to 4 K. The microscope will be placed in a ^{4}He cryogenic system with a superconducting coil (up to 17 Tesla) or in a standard lab Dewar for zero field measurements. An implemented cleaving mechanism allows sample preparation at low temperatures.

TT 10.5 Mon 14:00 Poster A

Broadband magnetodielectric spectroscopy in the millikelvin-regime — •Christoph Grams, Tim Steinmetzer, Florian Waschkowski, Daniel Niermann, and Joachim Hemberger — 2. Physikalisches Institut, Universiät zu Köln, Deutschland

Broadband dielectric spectroscopy provides a wealth of information on the polarization dynamics in condensed matter. Our goal is to measure the complex permittivity from 1 Hz to 20 GHz inside a top loading dilution refrigerator at temperatures down to 20 mK and magnetic fields up to 13 T. We use a frequency response analyzer for frequencies up to 10 MHz with shielded coax cables for measurements of the complex impedance. From 10 MHz to 20 GHz we realize coaxial reflection measurements employing a network analyzer and a microstrip sample-holder. One of the major problems with this setup is the calibration due to the temperature dependent internal reflections. The broad frequency range of the network analyzer allows the use of time-domain-gating as a secondary error correction. We present our calibration results and first reference measurements, e.g. on $SrTiO_3$ and the spin-ice $Dy_2Ti_2O_7$.

TT 10.6 Mon 14:00 Poster A

SQUID submicroemu ferromagnetic and superconducting signals embedded in much larger diamagnetic ones — •Ana Ballestar[1,2], Annette Setzer[2], Pablo Esquinazi[2], and Nicolas Garcia[1] — [1]Laboratorio de Fisica de Sistemas Pequeños (LFSPyN), Consejo Superior de Investigaciones Científicas (CSIC), Serrano 144, 28006 Madrid, Spain — [2]Division of Superconductivity and Magnetism Universität Leipzig, Linnéstraße 5, D-04103 Leipzig, Germany

Commercial superconducting quantum interferometer devices (SQUID) are widely used to measure small magnetic signals. In general, the SQUID signal is taken as a proof for the existence of ferromagnetic or superconducting phases in the samples. When magnetic moment signals below 1 μemu are present the situation is complicated due to the intrinsic resolution limits of the magnetometer. Measuring the response of a superconducting Pb-thin film on the surface of a graphite sample we were able to show that the sub-μemu signals of the ferromagnetic (from graphite) and superconducting (from Pb) phases are very well measured even when they are embedded in diamagnetic signals in the range of 4 to 30 μemu. Our work proves that it is possible to work with a commercial SQUID down to sub-μemu region after the subtraction of a large background signal coming from the same sample.

TT 10.7 Mon 14:00 Poster A

Multipurpose filter for high-resolution electronic measurements at very low temperatures — •Hans-Fridtjof Pernau[1], Christian Schirm[1], Christian Debuschewitz[2], and Elke Scheer[1] — [1]Department of Physics, University of Konstanz, D-78457 Konstanz, Germany — [2]Attocube Systems, Munich, Germany

Low-temperature transport measurements with high energy resolution require effective filtering of high-frequency input and an optimized thermal link between the electronic system and the thermal bath. Standard RC filters built from SMD or other discrete electronic elements provide a very sharp filtering characteristic. However, with those devices it is difficult to hinder crosstalk between in- and output. Their high dc resistance and restricted contact area results in considerable heat input. Furthermore the elevated dc resistance hampers measurements with high currents or voltages. We developed compact and reliable filters based on the filter concept presented by Martinis, Devoret and Clarke in 1987 [1] which we adapted to various purposes and shapes and to fit into almost every cryostat system. We present the manufacturing procedure, the filtering properties together with examples of implementations of our homemade copper and stainless steel powder filters which are used down to 10 mK.

[1] J.M. Martinis, M.H. Devoret and J. Clarke, Phys. Rev. B **35**, 4682 (1987)