TT 54: Poster Session: Cryotechnique

Time: Wednesday 15:00–19:00 Location: P2-OG3

TT 54.1 Wed 15:00 P2-OG3

Torque-detected electron spin resonance and torque magnetometry — •Alexey Alfonsov[1], Julian Zeisner[1], Vladislav Kataev[1], and Bernd Büchner[1,2] — [1]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden, IFW Dresden, D-01171 Dresden, Germany — [2]Technische Universität Dresden, D-01062 Dresden, Germany

Magnetic anisotropy is a key property of many materials, which has been under a great interest of scientists from around the world. The magnetic anisotropy is defined by the complex interplay of different degrees of freedom, such as spin or/and orbital moments, charge and lattice. One of the most appropriate methods to study magnetic anisotropies, and related properties is high field and multifrequency electron spin resonance (HF-ESR). Unfortunately samples of many new materials interesting for the investigation are available in very small sizes: in some cases it is complicated to synthesize large crystals, in other cases, the size is a key property of the material itself. This all rises a problem of the detection of the ESR signal from such a small sample, especially in the case of a multifrequency ESR spectrometer, where in order to increase the sensitivity one has to apply restrictions on the microwave frequency, strength and orientation of magnetic field. To overcome this problem we develope a multifrequency cantilever-based (torque-detected) ESR spectrometer, which, additionally, in the absence of the microwave radiation is transformed into a torque magnetometer.

TT 54.2 Wed 15:00 P2-OG3

Design of a 30 mK scanning tunneling microscope for spin-polarized measurements — •Sebastian Schimmel, Danny Baumann, Alexander Horst, Ralf Voigtländer, Dirk Lindackers, Bernd Büchner, and Christian Hess — IFW Dresden, Helmholtzstrasse 20, 01069, Dresden, Germany

We present the concept of a milli-Kelvin scanning tunneling microscope system, which is particularly designed for long term STM/STS and spinpolarized measurements at a base temperature of 30 mK within magnetic fields. The low temperature is provided by a 3He/4He Dilution Refrigerator that allows measurements with very high resolution in energy and real-space for up to 7 days without refilling the liquid helium reservoir. The position of our sample inside the STM is exactly at the center of a 9-4 T vector magnet that gives us the opportunity to systematically study local magnetic structures on the nanoscale by spinpolarized-STM/STS. Furthermore, the setup contains a two-chamber ultra-high-vacuum system for sample/tip preparation and storage. To avoid that any vibrations can be transferred to the STM the whole construction will be held by a two-stage passive/active damping system. With this contribution we would like to show our progress in setting up the mentioned 30 mK STM system.

TT 54.3 Wed 15:00 P2-OG3

A novel bridge-type radio frequency resonator for studying two level system dynamics under electric dc bias at low temperatures — •Sven Lutter, Benedikt Frey, Andreas Fleischmann, Andreas Reiser, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, D-69120 Heidelberg

The low temperature behavior of solids is well described by the standard tunneling model. Hereby, two level systems (TLS) are the dominant excitation in the solid. TLSs carrying an electric dipole moment couple to external electric fields and consequently can be studied in dielectric experiments. In particular, the application of an electric dc field is used to provide new insight into the TLS non-equilibrium dynamics.

We have developed a novel bridge-type radio frequency resonator. The capacitors of this resonator are arranged in a Wheatstone bridge-like configuration. Across one bridge diagonal the coil is attached, across the other the dc bias. The resonator is coupled inductively to the feed line and read out by a network analyzer.

We show first results on the optical glass N-BK7 for temperatures between a few millikelvins and several kelvins.

TT 54.4 Wed 15:00 P2-OG3

Development of a novel calorimetry setup based on metallic paramagnetic temperature sensors — •Andreas Reifenberger, Sebastian Kempf, Andreas Fleischmann, Rüdiger Klingeler, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, D-69120 Heidelberg

For the measurement of the specific heat of superconducting mg-sized metallic glass samples in the temperature range down to 10 mK we have developed a new microfabricated platform. It addresses challenging aspects of such a setup like the thermal contact between sample and platform, the necessary thermometer resolution and an addenda heat capacity excceeding that of the samples of interest (typically nJ/K @ 20 mK). Our novel setup is based on the relaxation method, where the thermal relaxation following a well defined heat pulse is monitored to extract the specific heat. The sample platform ($5 \times 5\,\mathrm{mm}^2$) includes a microstructured paramagnetic Ag:Er temperature sensor, which is read out by a dc-SQUID (Superconducting Quantum Interference Device) via a superconducting pickup loop. In this way, a relative temperature precision of $0.5\,\mu$K can be reached. A gold-coated mounting area ($4.4 \times 3\,\mathrm{mm}^2$) is included to improve the thermal contact between sample and platform. The performance of our setup is presented and discussed.

TT 54.5 Wed 15:00 P2-OG3

Novel microstructured superconducting resonator technique for measurements of dielectric polarization echoes — •Anna Pollithy, Andreas Schaller, Sergey Tsurkan, Andreas Reiser, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, D-69120 Heidelberg

The anomalous properties of amorphous solids at low temperatures are governed by tunneling systems, which are theoretically well described as two-level systems in the phenomenological standard tunneling model. These tunneling systems can couple resonantly to electric fields and can be studied by phase coherent methods such as dielectric two-pulse polarization echo measurements.

We have developed a new setup for performing polarization echo experiments on glasses, which is based on microstructured superconducting planar resonators. The resonance frequency and quality factor of such resonators can be predicted with confidence via simulations. Using this setup we aim to carry out echo experiments at different resonance frequencies and short pulse separation time. In the poster we present the new technique and show first experimental results for N-BK7 glass.

TT 54.6 Wed 15:00 P2-OG3

Development of microstructured superconducting resonators for broadband dielectric measurements of N-BK7 glass between 37 MHz and 1 GHz at low temperatures — •Benedikt Frey, Annina Luck, Andreas Fleischmann, Andreas Reiser, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, 69120 Heidelberg

The low temperature behavior of amorphous solids is determined by atomic tunneling systems and can be described by the phenomenological standard tunneling model (STM). Over the years, several experimental results showed significant deviations from this model, which led to a number of modifications of this theoretical description, e.g. an interaction between the tunneling systems.

In order to investigate the dielectric susceptibility of glasses in the MHz to GHz range, microstructured superconducting resonators on glass substrates were designed and fabricated. For the first time, such resonators were used for broadband measurements of the real and imaginary part of the dielectric function of the glass N-BK7 between 37 MHz and 1 GHz. A crossover from a one-phonon to a two-phonon based relaxation was observed in this frequency range, which is in accordance with the STM. In this frequency range, comparing low temperature data to the STM, suggests a modified density of states of tunneling systems in this material.

TT 54.7 Wed 15:00 P2-OG3

4 K Pulse Tube Cryocoolers: Solutions for "Dry" Cooling Applications with High Performance Requirements — •Jack-Andre Schmidt[2], Jens Falter[1], Bernd Schmidt[1,2], Marc

Dietrich[1,2], André Schirmeisen[1,2], and Günter Thummes[1,2] — [1]TransMIT-Center for Adaptive Cryotechnology and Sensors, Giessen, Germany — [2]Institute of Applied Physics (IAP), Justus-Liebig-University Giessen, Germany

Within the family of regenerative cooling systems, Pulse Tube Coolers (PTC) provide long life operation and low vibration due to the absence of moving parts inside the cold head. These advantages make PTC's the preferable choice for "dry" cryostats of low noise applications, where maintenance of the system is difficult. However, as a consequence of the periodic compression and expansion cycles of the process gas (Helium), they exhibit - as all cryocoolers - an intrinsic mechanical and thermal variation. In contrast to Gifford-McMahon coolers, PTCs are also bound to operate in vertical orientation. Due to these requirements in distinct cases, an adaption of the PTC to the individual cryostat design becomes necessary. Here we present the successful integration of a PTC into a unique cryostat for an airborne infrared telescope for radio astronomy [2]. Minimizing the intrinsic effects of the PTC down to the noise level of the measurement by suitable damping units is discussed as well as the high performance of the PTC, even operated under the tilting angle of the telescope.

[1] G. Thummes et al., Cryogenics, Vol. 38,3, (1998), 337-342
[2] C. Risacher et al., IEEE Trans. on THz Sci. and Tech., Vol. 6, Issue 2 (2015)

TT 54.8 Wed 15:00 P2-OG3

Effects of thermal non-equilibrium in precision measurements — •Rene Glaser[1], Giles D. Hammond[2], Stefanie Kroker[3], Frank Schmidl[1], and Ronny Nawrodt[1] — [1]Friedrich-Schiller University Jena, Institute for Solid State Physics, Helmholtzweg 5, 07743 Jena, Germany — [2]University of Glasgow, Institute for Gravitational Research, University Avenue, Glasgow G12 8QQ, United Kingdom — [3]Physikalisch-Technische Bundesanstalt, Metrology for Functional Nanosystems, Bundesallee 100, 38116 Braunschweig, Germany

Future gravitational wave detectors will very likely utilize silicon-based optics in order to increase their sensitivity. Crucial parts of these detectors, such as suspension elements, will be operated in a thermal non-equilibrium state. We present systematic investigations of the noise relevant properties under thermal non-equilibrium conditions.

TT 54.9 Wed 15:00 P2-OG3

Optical properties of silicon at low temperatures — •Fabian Ritschel[1], Rene Glaser[1], Stefanie Kroker[2], Johannes Dickmann[2], Carol B. Rojas-Hurtado[2], and Ronny Nawrodt[1] — [1]Friedrich-Schiller University Jena, Institute for Solid State Physics, Helmholtzweg 5, 07743 Jena, Germany — [2]Physikalisch-Technische Bundesanstalt, Metrology for Functional Nanosystems, Bundesallee 100, 38116 Braunschweig, Germany

Silicon is widely used in semiconductor industry for several optical applications but is also of great interest in optical applications. Especially in precision metrology applications, such as reference cavities or optical components in future gravitational wave detectors, it is currently of great interest. We summarize current efforts in order to investigate several optical parameters of silicon in a wide temperature range from 4.2 K up to 300 K.