TT 50: SC: Tunneling, Josephson Junctions, SQUIDs 2

Time: Thursday 14:00–15:15 Location: HSZ 301

TT 50.1 Thu 14:00 HSZ 301

Probing the superconducting state of $CeCoIn_5$ by quantum interferometry — •Oleksandr Foyevtsov, Fabrizio Porrati, and Michael Huth — Johann Wolfgang Goethe University, Frankfurt am Main, Germany

Josephson junction based structures provide a pathway to investigation of the superconducting state of unconventional superconductors. A superconducting quantum interference device (SQUID) structure was fabricated on micro-crystals of the heavy-fermion superconductor $CeCoIn_5$. Photo-lithography and ion beam milling/induced deposition were used to prepare the structure on a thin film of $CeCoIn_5$ grown via molecular beam epitaxy. The interferometer was characterized with regard to the SQUID properties. The unconventional nature of superconducting state in $CeCoIn_5$, the implications of the normal-state electronic properties, as well as the weak-link characteristics of the SQUID structure itself lead to a wealth of different features in the I(V) and dI/dV(V) characteristics.

TT 50.2 Thu 14:15 HSZ 301

Magnetic field sensors based on growth modified bi-crystal grain boundaries — •Peter Michalowski, Christian Katzer, Daniel Kuhwald, Matthias Schmidt, Veit Grosse, Frank Schmidl, and Paul Seidel — Friedrich-Schiller-Universität Jena, Institut für Festkörperphysik, Helmholtzweg 5, 07743 Jena, Germany

During the pulsed laser deposition of $YBa_2Cu_3O_{7-\delta}$ (YBCO) gold nano clusters forming from an intermediate gold layer can modify the growth and crystalline structure of the YBCO film [1]. In a similar way also the properties of grain boundaries of films grown on bi-crystal substrates can be modified by gold nano clusters. As a result Josephson junctions fabricated from these films typically show changes in their superconducting properties, especially in the critical current I_C, normal state resistance R_N and the I_CR_N product.

Based on the experimental results of simple dc-Superconducting QUantum Interference Device (SQUID) structures with and without crystalline gold clusters we produced and analysed dc-SQUID gradiometers.

We present results of the temperature dependence of the critical current, the SQUID modulation (transfer function) depending on bias current and temperature as well as the London penetration depth as a function of temperature.

[1] Grosse, V. et al. (2010), Formation of gold nano-particles during pulsed laser deposition of $YBa_2Cu_3O_{7-\delta}$ thin films. Phys. Status solidi (RRL) - Rapid Research Letters, 4: 97-99.

TT 50.3 Thu 14:30 HSZ 301

Systematic investigation of the current injection effect in $Bi_2Sr_2CaCu_2O_{8+\delta}$ — •S. Probst, X. Y. Jin, Y. Simsek, C. Steiner, and P. Müller — Department of Physics and Interdisciplinary Center for Molecular Materials (ICMM), Universität Erlangen-Nürnberg, Germany

By current injection we can change the properties of $Bi_2Sr_2CaCu_2O_{8+\delta}$ single crystals electronically in a wide range [1]. In order to investigate the doping process in greater detail, we have performed automated current injection experiments in very small bias current/voltage steps. By measuring the IV characteristics as well as doping current and doping voltage simultaneously, the change of superconducting properties is monitored. We were able to determine precisely the threshold-bias region where doping starts. We will discuss the observed phenomena and give an estimate for the depth of trap levels, which is crucial to understand the doping process.

[1] Y. Koval, X. Y. Jin, C. Bergmann, Y. Simsek, L. Ozyuzer, P. Müller, H. B. Wang, G. Behr, B. Büchner, Appl. Phys. Lett. **96**, 082507 (2010).

TT 50.4 Thu 14:45 HSZ 301

Superconductivity induced by current injection into non-superconducting $Bi_2Sr_2CaCu_2O_8$ — •Y. Simsek, Y. Koval, X. Y. Jin, S. Probst, and P. Müller — Department of Physics and Interdisciplinary Center for Molecular Materials (ICMM), Universität Erlangen-Nürnberg, Germany

We already have shown that we can change the carrier concentration of $Bi_2Sr_2CaCu_2O_{8+\delta}$ single crystals by current injection along the c-axis [1]. In this work, we focus on the interesting question: Can we induce superconductivity in non-superconducting $Bi_2Sr_2CaCu_2O_8$ merely by current injection? We report on current-injection experiments of fully oxygen depleted $Bi_2Sr_2CaCu_2O_8$ in which superconductivity was not observed down to 4.2 K. In order to eliminate the contact resistance of the highly resistive depleted material, we have fabricated double cross-bar crystal stacks. We have increased the c-axis conductivity by carrier injection until superconductivity above 4.2 K was observed. Doping the sample further by current injection, optimum-doped and even overdoped states were obtained. The current injection effect was persistent up to annealing temperatures of approximately 270 K.

[1] Y. Koval, X.Y. Jin, C. Bergmann, Y. Simsek, L. Ozyuzer, P. Müller, H. B. Wang, G. Behr, B. Büchner, Appl. Phys. Lett. **96**, 082507, 2010.

TT 50.5 Thu 15:00 HSZ 301

The tunnel barrier of intrinsic Josephson junctions in $Bi_2Sr_2CaCu_2O_{8+\delta}$ after doping by current injection — •X. Y. Jin, S. Probst, Y. Simsek, C. Steiner, Y. Koval, and P. Müller — Department of Physics and Interdisciplinary Center for Molecular Materials (ICMM), Universität Erlangen-Nürnberg, Germany

Superconductivity of $Bi_2Sr_2CaCu_2O_{8+\delta}$ single crystals can be tuned electronically in a wide range by current injection along the *c*-axis [1]. We investigate the change of superconducting properties after current injection by performing macroscopic quantum tunneling experiments of intrinsic Josephson junctions. An exponential increase of critical current density j_c with increase of hole concentration was observed. At the same time, microwave spectroscopy has shown that the junction capacitance per unit area increased by a factor of 5. Both experiments indicate that the tunnel barrier of intrinsic Josephson junction was significantly modified by the increase of the doping level.

[1] Y. Koval, X. Y. Jin, C. Bergmann, Y. Simsek, L. Ozyuzer, P. Müller, H. B. Wang, G. Behr, B. Büchner, Appl. Phys. Lett. **96**, 082507 (2010).