Forum DQMP

Tuesday, November 28 2017 - 13h00
Auditoire Stückelberg
Ecole de physique
Coffee and tea will be available from 12h50 at the entrance of the Auditoire

Ionic liquid gating of $YBa_2Cu_3O_{7-x}$ grain boundaries

Alexandre Fête (group of Prof. Senatore)

A widely accepted fact in the high-temperature superconductors community is that the major limiting factor to the spread of practical uses of $YBa_2Cu_3O_{7-x}$ (YBCO) is the exponential decay of its critical current (J_c) with grain misorientation (θ) in polycrystalline samples. More specifically, low-angle grain boundaries (LAGBs) represent an important bottleneck as second generation tapes cannot eliminate them completely.
In this work, we used the electric field produced by an ionic liquid (IL) to increase the critical current running through a LAGB. To achieve this, we grew by PLD few unit cell thick (≈5-10uc) epitaxial YBCO thin films on STO (001) bi-crystals (θ <10°) and gated them with an IL. This work is based on our previous work [1], where we demonstrated that the critical temperature and J_c of single-crystalline YBCO films can be increased respectively by a factor 2 and 8 using this technique. When applied to grain boundaries, ionic liquid gating offers the opportunity to follow a LAGB across its phase diagram and to better understand the factors limiting the supercurrent across it.

[1] A. Fête, L. Rossi, A. Augieri, C. Senatore, APL **109,** 192601 (2016)

Superconductivity at $LaAlO_3$/Ca-doped $SrTiO_3$ interfaces

Ritsuko Eguchi (group of Prof. Triscone)

Recent work has investigated the influence of ferroelectric fluctuations on superconductivity of doped $SrTiO_3$ [1]. A theoretical study predicts an enhancement of the superconducting transition temperature (T_c) for samples in the vicinity of the ferroelectric quantum critical point (QCP). Experimental studies on ferroelectric $SrTi^{18}O_3$ [2] and $Sr_{1-x}Ca_xTiO_3$ ($0.002 < x < 0.02$) [3] have indeed revealed that T_c is higher for ^{18}O and Ca-doped $SrTiO_3$ samples with respect to $SrTiO_3$ samples for the same doping level.
In this study, we investigate superconductivity at $LaAlO_3/Sr_{1-x}Ca_xTiO_3$ interfaces to clarify how the 2D electron liquid at the interface is affected by the ferroelectric QCP. A metallic behavior and a superconducting transition are observed in $SrTiO_3$ (6 u.c.)/$LaAlO_3$ (5 u.c.)/$Sr_{1-x}Ca_xTiO_3$ (x = 0.01) and $LaAlO_3$ (10 u.c.)/$Sr_{1-x}Ca_xTiO_3$ (x = 0.005 and 0.01) heterostructures, with values similar to the ones of the $LaAlO_3/SrTiO_3$ system. Using the field effect technique, we modulate the interface carrier density to see the dependence of the superconducting properties of the $LaAlO_3/Sr_{1-x}Ca_xTiO_3$ interfacial system on doping.

[1] J. M. Edge et al., Phys. Rev. Lett., 115, 247002 (2015).
[2] A. Stucky et al, Sci. Rep. 6, 37582 (2016).
[3] C. W. Rischau et al., Nat. Phys. 13, 643 (2017).

Forum Committee: C. Lichtensteiger, N. Ubrig, A. Tamai (23.11.2017)