TT 5: Postersession Superconductivity: Materials - Fabrication and Properties

Time: Monday 13:00–16:45 Location: P1A

TT 5.1 Mon 13:00 P1A

Superconductivity in Ga-doped Germanium — •R. Skrotzki[1], T. Herrmannsdörfer[1], V. Heera[2], O. Ignatchik[1], M. Uhlarz[1], A. Mücklich[2], M. Posselt[2], H. Reuther[2], B. Schmidt[2], K.-H. Heinig[2], W. Skorupa[2], M. Voelskow[2], C. Wündisch[2], and J. Wosnitza[1] — [1]Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf (FZD) — [2]Institut für Ionenstrahlphyik und Materialforschung, FZD

We report the first observation of superconductivity in heavily p-type doped germanium at ambient pressure conditions. Using Ga as dopant, we have produced a series of Ge:Ga samples by ion-beam implantation and subsequent short-term (msec) flash-lamp annealing. The combination of these techniques allows for Ga concentrations up to 6%, i.e., a doping level which is clearly larger than the solubility limit and not accessible to any other method so far. Transport measurements reveal superconducting transitions with T_c up to 0.5 K. In more detail, we observe a strong dependence of the superconducting critical parameters on the annealing conditions. Further, we find a strong anisotropy of the superconducting critical field reflecting the two-dimensional character of the superconducting state in the thin Ge:Ga layer having an effective depth of only 60 nm. We find critical magnetic in-plane fields even larger than the Pauli-Clogston limit. After its finding in Si [1] and diamond [2], our work reports another unexpected obervation of superconductivity in doped elemental semiconductors.

[1] E. Bustarret et al., Nature 444, 465 (2006).
[2] E. A. Ekimov et al., Nature 428, 542 (2004).

TT 5.2 Mon 13:00 P1A

Superconducting properties of boron-doped diamond — •M. Uhlarz[1], R. Skrotzki[1], T. Papageorgiou[1], J. Wosnitza[1,2], N. Dubrovinskaia[3,4], L. Dubrovinsky[5], N. Miyajima[5], A. Bosak[6], M. Krisch[6], H.F. Braun[7], and R. Wirth[8] — [1]Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf — [2]Institut für Festkörperphysik, TU Dresden — [3]Institut für Geowissenschaften, Universität Heidelberg — [4]Lehrstuhl für Kristallographie, Physikalisches Institut, Universität Bayreuth — [5]Bayerisches Geoinstitut, Universität Bayreuth — [6]European Synchrotron Radiation Facility, Grenoble — [7]Physikalisches Institut, Universität Bayreuth — [8]GeoForschungsZentrum Potsdam

The question of the nature of superconductivity in boron-doped diamond (synthesized at high pressures and high temperatures) is still open. Here we present consistent measurements of resistivity and specific-heat on two samples containing pure ^{13}C and ^{12}C, revealing a 0.2 K shift of the superconducting transition temperature T_c. Hall-coefficient measurements confirm equal charge-carrier concentrations in both samples. The results are interpreted as a carbon-isotope effect more than two times larger than expected from the most simple BCS model for phonon-mediated superconductivity. Additional analyses of microstructure and exact boron content of the superconducting material show the presence of highly boron-enriched amorphous boundaries between the grains. For these investigations high-resolution transmission-electron microscopy and electron-energy-loss spectroscopy were used.

TT 5.3 Mon 13:00 P1A

Substitution and pressure effect on superconducting properties of $Na_{1-x}Ca_xAlSi$ — •Andreea Beleanu[1], Vadim Ksenofontov[1], Claudia Felser[1], and Petre Badica[2] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, 55099 Mainz — [2]Institute of Physics Johannes Gutenberg - University, 55099 Mainz

This work reports on the substitution of Na^+ with Ca^{2+} in the ternary alkali-metal silicide superconductor NaAlSi. The superconducting transition of NaAlSi takes place at a critical temperature T_c of 7 K. The superconducting properties of CaAlSi were reported to the distortion of the AlSi-layers. The Si bonding network thus plays an important role for the superconducting characteristics[1]. CaAlSi shows a superconducting transition at a T_c of 8.0 K [2]. Na^+ and Ca^{2+} cations have equal ionic radii but Ca provides an additional electron. The observation of the superconducting properties in dependence of electron-doping of $Na_{1-x}Ca_xAlSi$ is shown. The superconducting properties of $Na_{1-x}Ca_xAlSi$ were measured using SQUID magnetometry.

[1] S. Kuroiwa, H. Kawashima, H. Kinoshita, H. Okabe, J. Akimitsu, Physica C, 466, 11 (2007).
[2] M. Imai, K. Nishida, T. Kimura, H. Kitazawa, H. Abe, H. Kito, K. Yoshii, arXiv:cond-mat/0210692v1,(2002)

TT 5.4 Mon 13:00 P1A

Superconducting Properties of Niobium Thin Films grown by Pulsed Laser Deposition — Christian Pansow[1], •Veit Grosse[1], Alexander Steppke[2], Frank Schmidl[1], and Paul Seidel[1] — [1]Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Helmholtzweg 5, 07743 Jena — [2]MPI für chemische Physik fester Stoffe, Nöthnitzer Straße 40, 01187 Dresden

Niobium (Nb) as the element showing the highest critical temperature is the most commonly used material for superconducting applications. High quality thin films can be fabricated utilising electron beam evaporation or sputtering. However, special demands on the device fabrication process may favour other deposition techniques. Note, for example, the possibility for an *in situ* growth of multilayer systems, the realisation of new Josephson Junction concepts utilising carbon nanotubes or improving film quality by increasing ionisation of the evaporated material. In this framework pulsed laser deposition is a versatile technique to meet these demands.

Here we report on the superconducting properties of niobium thin films grown by pulsed laser deposition at room temperature. Depending on film thickness we achieved a critical temperature of 8.4 K and a critical current density of $3.0 \cdot 10^6$ A/cm^2 at 4.2 K. We compare the temperature dependence of the critical current and critical magnetic field with that of electron evaporated niobium films. Our samples showed a distinct ageing behaviour during several cooling cycles which can be attributed to oxygen diffusion into the fine grained structure of the films.

TT 5.5 Mon 13:00 P1A

Tunneling into Al doped MgB_2 thin films — •Rudolf Schneider, Alexander G. Zaitsev, and Jochen Geerk — Forschungszentrum Karlsruhe, Institut für Festkörperphysik, 76021 Karlsruhe

Superconducting thin films with composition $Mg_{1-x}Al_xB_2$ ($0 \leq x < 0.6$) were prepared *insitu* by thermal sublimation of Mg combined with B rf and Al dc magnetron sputtering. The critical temperature, T_c, decreased linearly with a slope of -0.4 K per at% Al up to $x \approx 0.4$. For $0.4 < x < 0.5$ the formation of a plateau with a $T_c \approx 12$ K was observed. The plateau-like effect might be due to the formation of the superstructure $MgAlB_4$ with ordered alternating Mg and Al planes separated by B planes. Quasiparticle tunneling measurements were performed on sandwich-type crossed-strip tunnel junctions with artificial aluminum oxide barriers. Differential conductance measurements at low voltage allowed the determination of the small energy gap on the Fermi surface π sheet. The π gap decreased linearly with decreasing T_c of the films in agreement with a band filling model. Conductance measurements in the phonon region enabled the determination of the Eliashberg function α^2F for a low doping level $x \approx 0.1$ so far. Compared to the undoped MgB_2 a shift of the spectrum to higher energy was observed comparable to the renormalization of the phonon density of states measured on bulk samples with inelastic neutron scattering.

TT 5.6 Mon 13:00 P1A

Carbon Doping as an Effective Way to Enhance the Superconducting Properties of Mechanically alloyed in-situ MgB_2 — •Marko Herrmann[1], Wolfgang Hässler[1], Juliane Scheiter[1], Christian Rodig[1], Margitta Schubert[1], Ania Kario[1], Christine Mickel[1], Nadezda Kozlova[1], Konstantin Nenkov[1], Manfred Ritschel[1], Wolfgang Gruner[1], Ludwig Schultz[1,2], and Bernhard Holzapfel[1,2] — [1]Leibniz Institute for Solid State and Materials Research (IFW) Dresden, P.O.Box 270116, 01171 Dresden, Germany — [2]Dresden University of Technology, Department of Physics, 01062 Dresden, Germany

Up to now, carbon doping is the only reliable way to enhance the superconducting properties of Mg_2 significantly. Due to the substitution of carbon on boron sites of the lattice, increased impurity scattering results in an enhanced upper critical field. Subsequently, an improved high field j_c-performance of carbon-doped MgB_2 is observed. Among the plethora of carbon-containing compounds studied so far, nanos-