TT 7.7 Mon 14:00 P1

Influence of aluminium substitution on the heat transport in single crystalline MgB_2 — •A.V. Sologubenko[1,2], N.D. Zhigadlo[2], S. M. Kazakov[2], J. Karpinski[2], and H.R. Ott[2] — [1]II. Physikalisches Institut, University of Cologne, 50937 Cologne, Germany — [2]Laboratorium für Festkörperphysik, ETH Hönggerberg, CH-8093 Zürich, Switzerland

We report data on the thermal conductivity $\kappa(T,H)$ of single-crystalline superconducting $Mg_{1-y}Al_yB_2$ ($y = 0.02, 0.07$) in the normal and mixed states at temperatures between 0.5 and 50 K, and in external magnetic fields H up to 50 kOe. The results are analyzed in terms of a combined phononic (κ_{ph}) and quasiparticle (κ_e) heat transport and compared with our earlier results on pure and carbon-doped MgB_2. The substitution of Al for Mg leads to a considerable reduction of the field-induced κ_e, while κ_{ph} seems to be much less sensitive to impurities. The analysis of the $\kappa_e(H)$ data leads to the conclusion that the introduction of aluminium results in comparable enhancement of the intraband scattering in both the σ- and the π-band. This is in contrast to the carbon substitution for boron, which enhances mostly the intraband scattering in the σ-band. The interband scattering is rather weak in both cases.

TT 7.8 Mon 14:00 P1

Microwave properties of MgB_2 thin films prepared in situ by thermal evaporation combined with sputtering — •Rudolf Schneider, Alexander G. Zaitsev, Roland Hott, Fritz Ratzel, and Jochen Geerk — Forschungszentrum Karlsruhe, Institut für Festkörperphysik, P.O.B. 3640, D-76021 Karlsruhe, Germany

Superconducting MgB_2 thin films were prepared *in situ* using a combination of rf magnetron sputtering of B and thermal evaporation of Mg. The films exhibited T_c of up to 36 K. Microwave measurements were performed on 14×14 mm^2 films using both Cu-shielded and Nb-shielded sapphire puck resonators at the frequency of 18.8 GHz. The hf surface resistance (R_s) and the change of the hf surface reactance (ΔX_s) were determined. The films exhibited low R_s matching the literature results for high-quality MgB_2 films. Below 3 K R_s reached 3-5 $\mu\Omega$ which was the resolution limit of our measurement. The temperature dependence of both R_s and ΔX_s were in good agreement with BCS theory. From the $R_s(T)$ dependence we obtained an energy gap $\Delta(0) \approx 3$ meV. The measured variation of the London penetration depth with temperature, $\Delta\lambda_L(T)$, was also in good agreement with the BCS model. Using the BCS relation between the energy gap and the penetration depth we fitted our experimental $\Delta\lambda_L(T)$ data and obtained $\lambda_L(0)$ values which ranged for different films from 85 to 100 nm.

TT 7.9 Mon 14:00 P1

Effect of impurity additions on the superconducting properties of in situ-processed MgB_2 — •Marko Herrmann[1], Margitta Schubert[1], Wolfgang Häßler[1], Bernhard Holzapfel[1], and Ludwig Schultz[1,2] — [1]IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany — [2]Dresden University of Technology, Department of Physics, Institute for Physics of Solids, D-01062 Dresden, Germany

The MgB_2 powder was prepared by mechanical alloying of Mg, amorphous Boron and the additive. For studying the influence of the additive on the superconducting properties its amount was varied up to 20 m-%. Single elements as carbon as well as compounds like SiC were used as dopants. The result of the milling process was a partially reacted nano-sized precursor powder with a high reactivity which was hot pressed to bulk samples. Starting from the undoped MgB_2 with a critical temperature of 36 K and best current densities of 10 kA/cm^2 at 7.5 K and 4 T, the changes of the superconducting properties with the kind and amount of additive are described in detail.

TT 7.10 Mon 14:00 P1

TEM cross-section analysis of $La_2Zr_2O_7$ buffer layers for YBCO-coated conductors prepared by chemical solution deposition — •Leopoldo Molina[1], Sebastian Engel[2], Kerstin Knoth[2], Bernhard Holzapfel[2], and Oliver Eibl[1] — [1]Institute of Applied Physics, University of Tuebingen, Auf der Morgenstelle 10, D-72076 Tuebingen, Germany — [2]IFW Dresden, Leibniz Institute for Solid State and Materials Research Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany

Chemical solution deposition is a promising method to fabricate low cost buffer layers for YBCO-coated conductors. In this study we present transmission electron microscopy (TEM) analysis of cross-sectional and plan-view prepared $La_2Zr_2O_7$ buffer layers on biaxially textured Ni-W substrates for YBCO-coated conductors prepared by chemical solution deposition methods. The $La_2Zr_2O_7$ buffer layers were deposited on 100 μm thick Ni-W substrate and were heat treated at 900°C and 1050°C. TEM cross-section samples were prepared by conventional mechanical polishing and ion milling techniques. By means of transmission electron microscopy the grain size, the buffer layer thickness, the void size and void density and the orientation of LZO with respect to the Ni substrate was determined. The Ni-W substrate interface with the $La_2Zr_2O_7$ buffer layer was also investigated. Using two-beam imaging conditions bright-field, dark-field and energy spectroscopic images (ESI) were acquired. Chemical composition determination of the films and substrate was done by energy dispersive X-ray microanalysis (EDX).

TT 7.11 Mon 14:00 P1

Optimisation of $La_2Zr_2O_7$ buffer layers and CeO_2 cap layers on Ni RABiTS for YBCO coated conductors using chemical solution deposition — •Sebastian Engel, Kerstin Knoth, Thomas Thersleff, Heike Schlörb, Ruben Hühne, Ludwig Schultz, and Bernahrd Holzapfel — IFW Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany

Chemical Solution Deposition (CSD) has been used to prepare biaxially textured cerium oxide cap layers and $La_2Zr_2O_7$ (LZO) buffer layers on Ni RABiTS. For the cerium oxide cap layer, a precursor solution consisting of dissolved Ce(III)-acetate in propionic acid, 2,5-pentandion, and 2-propanol was used. The LZO precursor solution was prepared by dissolving La-, and Zr-2,4-pentanedionates in propionic acid. Both, prepared buffer and cap layers were dip-coated and subsequently heat-treated at various temperatures between T = 900°C and 1100°C under different gas flow conditions. The surface texture quality was analysed with Reflection High Energy Electron Diffraction (RHEED) and Electron Back Scattering Diffraction (EBSD). EBSD maps show nearly 100 % biaxially textured surfaces for the optimised LZO buffer layers and cerium oxide cap layer. Further surface properties were investigated by atomic force microscopy and secondary electron microscopy. 300nm thick $YBa_2Cu_3O_{7-\delta}$ test structures were prepared on this buffer layer system CeO_2 (CSD)/LZO (CSD)/ Ni-5 % W tape by pulsed laser deposition and characterised by resistivity measurements at 77 K in magnetic fields up to 9 T.

TT 7.12 Mon 14:00 P1

All CSD $YBa_2Cu_3O_{7-\delta}$ coated conductor on cube textured Ni-W substrates — •Kerstin Knoth, Sebastian Engel, Ruben Hühne, Steffen Oswald, Brigitte Schlobach, Steffen Strehle, Ludwig Schultz, and Bernhard Holzapfel — IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Chemical Solution Deposition (CSD) was used as a low cost method to prepare an all CSD $YBa_2Cu_3O_{7-\delta}$ (YBCO) coated conductor having a YBCO/CeO_2/$La_2Zr_2O_7$ (LZO)/Ni-5at%W architecture. The LZO and CeO_2 precursor solutions were prepared using new solution routes, whereas the trifluoroacetate (TFA) process was used for the preparation of the YBCO layer. A highly textured LZO/CeO_2 architecture was obtained on Ni-W after annealing at $T_A = 900$ °C in a reducing atmosphere. The TFA-YBCO layer was deposited afterwards and annealed at $T_A = 780$ °C. The characterization of the CSD YBCO coated conductor was done using X-Ray Diffraction (XRD), Reflection High Energy Electron Diffraction (RHEED), SEM, AFM, X-Ray Photoelectron Spectroscopy (XPS) and cross sectional analysis using the Focussed Ion Beam (FIB) technique. The TFA-YBCO(200 nm)/CeO_2(60 nm)/LZO(400 nm)/Ni-W coated conductor showed a T_c of 91.0 K with a ΔT_c of 1.2 K. The critical current density J_c was below 1.0 MA/cm^2 compared to a PLD-YBCO/PLD-CeO_2/LZO(400 nm)/Ni-W test sample (PLD - Pulsed Laser Deposition) with $J_c = 1.0$ MA/cm^2. Nevertheless, these results are very promising towards the realization of an all CSD YBCO coated conductor.

TT 7.13 Mon 14:00 P1

Effect of H_2S treatment on the orientation and texture sharpness of MgO buffer layers on highly cube textured Ni-4at.%W tapes as a template for YBCO coated conductors — •Rainer Nast[1], Bernhard Obst[1], Oliver Stadel[2], and Wilfried Goldacker[1] — [1]Forschungszentrum Karlsruhe, Institut für Technische Physik, Postfach 3640, D-76021 Karlsruhe — [2]TU Braunschweig, Institut für Oberflächentechnik (IOT), Bienroder Weg 53, D-38108 Braunschweig

To achieve high current carrying capabilities in YBCO coated conductors based on cube textured metal substrates, the texture and stability of the buffer/metal interface is a necessary requirement. In this work cube textured Ni-4at.%W substrate tapes were subjected to different H_2S treatments and the texture development of post-deposited MgO buffer layers was studied. The in-plane orientation and the texture sharpness of the MgO layers was found to depend strongly on the heat treatment time in Ar-10 ppm H_2S. Increasing the time from 5 to 60 min at 800°C changes the in-plane orientation from 45° over 0° to 45° at 15 min and the texture sharpens continuously to an FWHM (220) of < 6°.

TT 7.14 Mon 14:00 P1

Physical properties of chemically deposited $La_2Zr_2O_7$ and CeO_2 buffer layers on cube textured Ni-4 at.% W substrates — •Gunter Kotzyba, Bernhard Obst, Rainer Nast, and Wilfried Goldacker — Forschungszentrum Karlsruhe, Institut für Technische Physik, P.O. Box 3640, 76021 Karlsruhe

The chemical solution deposition route for YBCO-coated conductors is of interest as a promising way to develop a low cost conductor. Thin films of $La_2Zr_2O_7$ and CeO_2 were prepared on Ni-4 at.% W by dip coating. The layers serve as buffer for depositing superconducting YBCO on top of it. We systematically investigated the dependence of the thickness on the viscosity and the concentration of the La (III) and Ce (IV) precursor solutions by means of a cone plate rheometer and an ICP OES. The roughness was analysed with a profilometer, the thickness determination was done by X-ray microanalysis. EBSD mappings show very good cube in-plane and out-of-plane texture.

TT 7.15 Mon 14:00 P1

dc and rf transport in normal and superconducting HTS, MgB_2, and Nb networks — •Jürgen Halbritter — Forschungszentrum Karlsruhe, Postfach 36 40

Island/grain boundaries occur naturally in film growth or sintering. The hindrance of electric transport by boundary resistances $R_{bn}(Wcm^2)$ in distances $a_J(\leq 10mm)$ is easy to measure in normal conducting transport in such granular networks. The resistivity $r(T) = R_{bn}/a_J + p(\rho^i(T) + \rho^i(0))$ is fitted to observations with percolation factors $p > 1$ by current diverting $a_J\rho^i(300K)$ boundaries with $R_{bn} \geq a_J\rho^i(300K)$ where $\rho^i(T) + \rho^i(0)$ is due to the grain interior (IG) and R_{bn}/a_J and p describes the effects of boundaries (GB) and the network. In the superconducting transport GB may act as Josephson junctions (JJ) with $j_{cJ}(A/cm^2)$ as current density. For superconducting networks is a simple separation in IG and GB not possible. But low I_c values, $p > 1$ and large R_{bn} values are clear indications for growth boundary limitations. Analysis of $I_c(T, B, q, \omega)$ as junction of temperature, field B, angle q and frequency ω give crucial information about GB and flux low or pinning of Josephson (JF) or Abrikosov fluxons (AF) in the network. The combination of normal and superconducting analysis is of crucial importance for dc, ac and rf engineering applications and for the understanding of the related material science.

TT 7.16 Mon 14:00 P1

Electronic structure calculations for YBCO/metal interfaces — •Udo Schwingenschlögl and Cosima Schuster — Institut für Physik, Universität Augsburg, 86135 Augsburg

Transport properties of heterostructures consisting of a metal and a correlated superconductor are of great importance for electronic devices based on HTSC. Using electronic structure calulations within density functional theory and the local density approximation, we investigate YBCO/metal interfaces. As the lattice mismatch between YBCO and Pd is rather small (0.7%), we choose Pd as the metallic constituent. It is generally accepted that the carrier density is modified at grain boundaries. Since this band bending should take place on the length scale of the lattice constant it can be reproduced by LDA supercell calculations. In particular, we use a supercell consisting of two YBCO unit cells alternating with five Pd layers along the orthorhombic c-axis. Following experimental results, the YBCO layers entering our calculations terminate by CuO chains.

Our results show that the electronic density of states at the interface depends crucially on the details of the local atomic structure. Therefore we have relaxed the atomic positions to minimize the forces on the ions. We compare two possible interface geometries, where the Pd atoms are placed on the Cu or O atoms of the CuO chains, respectively. For these configurations we determine the charge distribution across the interface.

TT 7.17 Mon 14:00 P1

Characterization of Top-Seeded Melt-Grown Bulk Superconductors by Hall Probe Mapping Techniques — •S. Haindl[1], H.W. Weber[1], N. Hari Babu[2], D. A. Cardwell[2], S. Meslin[3], J. Noudem[3], L. Shlyk[4], and G. Krabbes[4] — [1]Atomic Institute of the Austrian Universities, TU Vienna, Austria — [2]IRC in Superconductivity, University of Cambridge, UK — [3]CRISMAT-ENSICAEN, CNRS/UMR, France — [4]IFW Dresden, Germany

We report on the characterization of top-seeded melt-grown (TSMG) single grain bulk superconductors by two Hall probe mapping techniques. Scanning the trapped field distribution following magnetization of the sample in an external field is an established method of characterizing these materials. This technique enables both determination of the maximum trapped field after complete field penetration of the bulk sample, and identification of growth-induced inhomogeneities within the sample microstructure. A new mapping technique known as Magnetoscan has been developed over the past two years and recently improved to yield more useful information about the quality of bulk superconductors. This technique involves scanning simultaneously a small permanent magnet and a Hall probe over the unmagnetized superconducting surface of the bulk sample. Interesting results have been obtained using the magnetoscan technique, including direct imaging of different growth sectors in bulk samples and the identification of inhomogeneities such as cracks and grain-boundaries and the mapping of artificial holes in the single grain microstructure.

TT 7.18 Mon 14:00 P1

Nanometer-scale superconducting domains observed on $NdBa_2Cu_3O_{7-\delta}$ — •Pintu Das[1], Dirk Mautes[1], Michael R. Koblischka[1], Thomas Wolf[2], and Uwe Hartmann[1] — [1]Institute of Experimental Physics, University of Saarbruecken, D-66041 Saarbruecken, Germany — [2]Forschungzentrum Karlsruhe GmbH, Instiitute of Solid State Physics, D-76021 Karlsruhe, Germany

In understanding high temperature superconductivity, the recent focus is at the local-scale electronic modulation and its influence towards superconductivity in general. The granular structure and atomic-scale modulation of the density of states in $Bi_2Sr_2CaCu_2O_{8+\delta}$ have been observed [1,2]. Here we report Scanning Tunneling Spectroscopic (STS) results obtained on the (ab) plane of a slightly underdoped $NdBa_2Cu_3O_{7-\delta}$ (T_c= 93.5 K) twinned single crystals at 4.2 K. Recent results proved that the NdBCO surface is highly clean and stable in air, showing atomic resolution at room temperature [3]. We used the STS imaging technique to study the electronic inhomogeneity and we observe that there are superconducting domains of ∼ 3 nm length scale separated by nonsuperconducting regions, similar to that observed in $Bi_2Sr_2CaCu_2O_{8+\delta}$. In the superconducting domains, the size of the energy gap spatially varies from ∼ 16 meV to ∼ 44 meV. The average gap size is found to be ∼ 22 meV. We discuss these data and the possible origin of the inhomogeneous electronic structure of the respective materials.

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[2] McElroy et al., Nature 422, 592 (2003)
[3] Ting et al., Appl. Phys. Lett. 72, 2035 (1998)

TT 7.19 Mon 14:00 P1

Nanoscale stripe structures in $SmBa_2Cu_3O_x$ superconductors — •M. Winter[1], M. R. Koblischka[1], Th. Wolf[2], X. Yao[3], A. Hu[4], and U. Hartmann[1] — [1]Institute of Experimental Physics, University of Saarbrücken, P.O.Box 151150, 66041 Saarbrücken, Germany — [2]Forschungzentrum Karlsruhe GmbH, Institute of Solid State Physics, D-76021, Karlsruhe, Germany — [3]Department of Physics, Shanghai Jiao Tong University, 1954 Huashan Road, Shanghai 200030, P. R. China — [4]Department of Physics, University of Waterloo, 200 Univ. Ave. West, Waterloo, ON N2L 3P7, Canada

AFM and STM scans on $SmBa_2Cu_3O_x$ (SmBCO) melt-processed samples prepared using different techniques revealed the presence of nanoscale stripe-like structures, sometimes parallel over several micrometers, sometimes wavy. These structures consist of chemical compositional fluctuations and act as effective δT_c pinning centers due to their wavelength of typically 10-60 nm which is comparable to the ideal pinning-center size of 2 ξ (10 nm for $YBa_2Cu_3O_x$ in the ab-plane). Compared to similar structures in ternary (Sm,Eu,Gd)$Ba_2Cu_3O_x$ (SEG) and (Nd,Eu,Gd)$Ba_2Cu_3O_x$ (NEG)) systems, where the stripes appear either as plateau-like stripes or as chains of aligned clusters, the stripes in SmBCO always appear as plateau-like stripes with a height of 1 Å- 8Å. These pinning structures throughout the whole sample volume may be a key