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NOTA BENE:

Josephson Vortices

The interlayer Josephson vortices emerging from the ac face of single crystals of the single-layer cuprate high-T_c superconductor *(Hg,Cu)*$Ba_2CuO_{4+\delta}$ have been imaged by J. R. Kirtley (IBM-Yorktown) et al. using a scanning SQUID microscope. The images provide a direct measurement of the c-axis penetration depth, $\lambda_c \sim 10\ \mu m$. This length is a factor of 10 larger than predicted by the interlayer tunneling (ILT) model for the mechanism of superconductivity in layered compounds [S. Chakravarty et al., *Science* **261**, 337 (1993); P. W. Anderson, *Science* **268**, 1154 (1995)], indicating that the condensation energy available through this mechanism is 100 times smaller than is required for superconductivity.

Intrinsic pinning of Josephson vortices in $Bi_2Sr_2CaCu_2O_{8+\delta}$ has been studied by H. Haneda (Kyoto) et al. via measurements of the mutual conversion between ultrasonic waves and electromagnetic waves. From the dependence of this effect upon the angle of the applied magnetic field relative to the CuO_2 planes, the authors observe a crossover from intrinsic pinning to pancake pinning.

The equilibrium magnetization for layered superconducting films that experience a nonzero component $H_{||}$ of magnetic field applied parallel to the layers has been computed by J. P. Rodriguez (Madrid and Cal State - Los Angeles) at temperatures and magnetic fields near the decoupling transition. The author finds that the parallel magnetization has an anomalous $H_{||}^{-1}$ tail at high fields due to entropic fluctuations of the lattice of Josephson vortices.

More Vortices

An extensive numerical study of vortex matter has been carried out by H. Nordborg (ETH-Zürich and Argonne) and G. Blatter (ETH-Zürich) using the mapping to 2D bosons and path-integral Monte Carlo simulations. The authors find a first-order vortex-lattice melting transition into an entangled vortex liquid. The jumps in entropy and density are consistent with experimental results on $YBa_2Cu_3O_{7-\delta}$. The liquid is denser than the solid. In the language of bosons, the authors find a sharp quantum phase transition from a Wigner crystal to a superfluid, even in the case of logarithmic interaction.

The translational order in a three-dimensional vortex lattice pinned by hopping defects, such as oxygen vacancies, has been studied theoretically by E. M. Chudnovsky (CUNY Lehman College). The author finds that long-range order in the vortex lattice is restored as the thermal hopping rate increases. The author suggests that this phenomenon, which would be equivalent to a thermal depinning transition, may occur in the low-field, high-temperature part of the field-temperature phase diagram.

Pinning by splayed and columnar defects created by 3.9 GeV $^{197}Au^{29+}$ ions has been investigated by W. K. Kwok (Argonne) et al. using transport measurements of vortex motion perpendicular and parallel to the splay plane in untwinned crystals of $YBa_2Cu_3O_{7-\delta}$. The authors compare these results with those from a sample with parallel columnar defects parallel to the c axis, and they report extensive measurements of the temperature, field, and angular dependencies of the vortex liquid and solid states. The authors find that the irreversibility lines for pre- and post-irradiated splayed-defect samples cross at twice the matching field. The authors also determined the vortex liquid pinning energy for splayed and columnar defects and found that the barrier to vortex motion perpendicular to the splay plane is greater than that to motion parallel to the splay plane.

Closed-form results for the vortex inertial mass due to variation of the magnitude of the superconducting order parameter are presented by M. W. Coffey (Colorado) for an s-wave superconductor. Certain matrix elements

that use approximate wave function solutions of the Bogoliubov-de Gennes equations are evaluated. The resulting analytic expressions characterize the inertial mass and the core polarizability, and are suitable for incorporation in the vortex mobility at zero temperature.

The interaction between a magnetized probe tip and a superconducting sample, the basis for the imaging technique of magnetic force microscopy (MFM), has been calculated by M. W. Coffey (Colorado). The first part of the paper addresses the force between the probe tip and a vortex in the superconductor. The second part of the paper describes an MFM measurement method for determining the penetration depth profile when λ depends upon the distance z from the surface.

Flux Motion

Two preprints by E. H. Brandt (MPI-Stuttgart) report theoretical developments regarding flux motion in type-II superconductors. In one of these, the author shows how to calculate the current density **J**(**r**,t) and magnetic induction **B**(**r**,t) in a superconductor with arbitrary shape and material laws **H**(**B**,**r**) (equilibrium field) and **E**(**J**,**B**,**r**) (electric field caused by flux-line motion) when a magnetic field $\mathbf{B}_a(\mathbf{r},t)$ and a current are applied. The author then calculates the geometric edge barrier for flux penetration, the current density at the flux front, and the field of first flux entry B_{en} for superconducting strips of rectangular cross section in a perpendicular field. In the other preprint, Brandt calculates the complex ac susceptibility $\chi = \chi' - i\chi''$ for superconducting cylinders of radius a and length 2b in parallel or perpendicular magnetic field using the model $E \propto J^n$. Results for χ' and χ'' are shown for ohmic (n = 1) cylinders with various aspect ratios (b/a = 0, 0.01, 0.03, 0.1, 0.3, 1, 2, 3, 5, and 10) and for nonohmic (n = 3, 5, 11, and 51) cylinders with aspect ratio b/a = 1.

A preprint by M. Däumling (TU-Denmark) reports numerical computations of the critical-state magnetic field and current distributions for a superconducting strip of infinite length but finite thickness and width carrying an ac transport current. The aspect ratio (width/thickness) was varied from 1 to 100, covering the range from square bars to thick films. The calculated power-loss exponents n ($P \propto I^n$) were found to vary from roughly 3 for a square bar to about 4 in a highly aspected thin strip. In the thin-film case, the power-loss exponents are current-dependent because of the contribution to the loss caused by the component of the magnetic field parallel to the strip. The author also calculated the maximum magnetic fields that occur and found that they fall on a universal curve that depends only on the aspect ratio.

Curves of E vs. J (local electric field versus current density) in $YBa_2Cu_3O_{7-\delta}$ and $Nd_{1.85}Ce_{0.15}CuO_{4-\delta}$ single crystals have been measured by D. Giller et al. (Bar Ilan) using a miniature Hall-sensor array. Measurements in the field range corresponding to the anomalous magnetization peak reveal different E-J characteristics above and below the peak, indicating a crossover in the flux-creep mechanism. The authors expect this E-J behavior to be universal in all superconductors exhibiting the anomalous peak.

A reentrant behavior of the peak effect has been found by S. S. Banerjee (TIFR-Mumbai) et al. in a single crystal of the anisotropic superconductor 2H-$NbSe_2$ via electrical transport and dc magnetization studies: when plotted in the H-T plane, H_p (the value of the field where the peak effect occurs) is double-valued for temperatures near T_c. The authors find that the upper (high-field) branch of the H_p vs. T curve is relatively unaffected by disorder, while the lower (low-field), reentrant branch of the curve is strongly affected by disorder.

$RBa_2Cu_3O_{7-\delta}$

As reported by D. A. Wright et al. (UC-Berkeley and LBNL), the temperature (T) and magnetic field (H) dependencies of the specific heat of $YBa_2Cu_3O_{7-\delta}$ *(YBCO)* show a number of features predicted for d-wave pairing: a T^2 term for H = 0 and an $H^{1/2}T$ term for $H \neq 0$ and low T, with a crossover to a stronger T dependence at higher T. For all H and T, the authors find the results to be consistent with a recently proposed scaling relation. The observed values of the crossover parameter and the coefficients of the T^2 and $H^{1/2}T$ terms are in good agreement with theoretical calculations.

Strong evidence for both spin-2 and spin-1/2 paramagnetic centers in $YBa_2Cu_3O_{7-\delta}$ has been found by J. P. Emerson et al. (UC-Berkeley and LBNL) in specific-heat data in the vicinity of 1 K. This work provides a basis for the determination of more reliable values for all parameters derived from low-temperature specific-heat data. The authors report the concentrations of both kinds of paramagnetic centers, Debye temperatures, and the coefficients of the T-proportional term for $0 \leq \delta \leq 0.2$.

Copper isotope shifts of T_c have been measured by D. E. Morris et al. (Morris Research) in *123* and *124* cuprate superconductors with partial substitutions by *Pr* and *La* to reduce hole concentration. The *123* compositions were $Pr_xY_{1-x}Ba_2Cu_3O_7$ (x = 0.2, 0.3, 0.4) and $YLa_{0.3}Ba_{1.7}Cu_3O_7$. The *124* compounds were $Pr_xY_{1-x}Ba_2Cu_4O_8$ (x = 0.2, 0.3) and $YLa_{0.3}Ba_{1.7}Cu_4O_8$. Oxygen isotope experiments in materials with these compositions have shown substantial isotope shifts. The authors found that (a) the *Cu* isotope shifts are also substantial, but somewhat smaller, (b) the *Cu* isotope exponent α_{Cu} is positive, (c) α_{Cu} increases rapidly as T_c is reduced by substitution

and rises to a substantial fraction of the BCS value, behavior that is similar to that of the oxygen isotope exponent α_O, and (d) when T_c is reduced by non-isovalent substitution, both α_O and α_{Cu} increase greatly, but the ratio α_{Cu}/α_O remains 0.75 ± 0.1 in both *123* and *124*, regardless of the amount and site of the non-isovalent substitution.

Bi Cuprates

Angle-resolved photoemission data by Z.-X. Shen (Stanford) et al. above and below the superconducting transition temperature T_c of $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* reveal momentum-dependent changes that extend up to an energy of about 300 meV (or 40 k_BT_c). The data suggest an anomalous transfer of spectral weight from one momentum to another, involving a sizable momentum transfer **Q** ~ (0.45π,0). The authors note that the observed **Q** is intriguingly near the required charge-order periodicity if fluctuating charge stripes are present.

The spectral function of the electron-phonon interaction $\alpha^2F(\omega)$ determined by a tunneling experiment has been compared by D. Shimada (Shizuoka) et al. with the calculated phonon density of states for $Bi_2Sr_2CaCu_2O_{8+\delta}$. The authors find considerable agreement between the two spectra. In particular, they find that a large dip in $\alpha^2F(\omega)$ at 27 meV is reproduced in the calculated density of states. The authors also present the atomic polarization vectors and the frequencies of the most important modes, and they conclude that vibrations of oxygen atoms along the c axis and low-frequency cation vibrations are especially important.

Cleaved surfaces of $Bi_2Sr_2CaCu_2O_{8+\delta}$ (T_c = 86 K) have been investigated by S. Kaneko (Tokyo Tech) et al. using low-temperature scanning tunneling spectroscopy. The clean surface was prepared by cleaving the sample at liquid-helium temperature in a vacuum. The tunneling spectra have a broad bump, consisting of two peaks at bias voltages ~30 mV and ~40 mV, just outside a superconducting gap. Because of the broad bump, the spectra cannot be fitted by the theoretical bulk density of states of either s-wave or d-wave superconductors. The authors note that the shape of the measured spectra is similar to the spectra calculated in the 2D Hubbard model.

$(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$*/Ag* coils and magnets have been fabricated by N. V. Vo (Los Alamos) using both the wind-and-react (W-R) and the react-and-wind (R-W) approach. The author constructed a test magnet from double pancake coils fabricated by the W-R procedure; the magnet generated a field of ~30 mT at 77 K. Superconducting straps were used to connect the double pancakes.

Superconducting joints between monofilamentary *Ag*-sheathed $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ tapes have been investigated by M. R. Koblischka (Oslo) et al. using magneto-optical imaging. Two types of joints were studied, one with direct contact between the tape cores, and the other with a *Ag* layer between them. The local flux distributions directly revealed the obstacles hindering the current flow through the joints. The joints with direct contact between tape cores had a critical current about 80% of that of the original tape, while the joints with a *Ag* layer between them were considerably worse. The difference became even more pronounced in applied magnetic fields.

A related paper by M. R. Koblischka (Oslo) et al. reports magneto-optical imaging of the entry and exit of magnetic flux into a *Ag*-sheathed $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ multifilamentary tape in an applied magnetic field. In low fields, the shielding currents were found to flow mostly in the outermost filaments. The magneto-optical flux patterns also revealed that the filaments in the tape are coupled together, which enables current to flow around defects within the filaments.

As reported by V. Rouessac et al. (Caen), transport critical current measurements have been performed at 77 K on bulk silver-free $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ ceramics textured by the sinter-forging method. The authors discuss the influences of the 85 K superconducting *2212* phase and the nonsuperconducting secondary phases, such as $(Sr_xCa_{1-x})_2PbO_4$, $(Sr,Ca)_{14}Cu_{24}O_y$, and $(Sr_xCa_{1-x})_2CuO_3$, in terms of their amounts, grain sizes, shapes, and distribution within the *2223* matrix. The authors also demonstrate the importance of the temperature profile and the atmosphere during post sinter-forging annealing.

A preprint by S. Kambe (Yamagata) et al. reports the effect of pressing and *Li* doping on the properties of *Ag*-sheathed *Bi-2223* tapes. The authors found that increasing the pressing pressure from 1 t/cm^2 to 10 t/cm^2 increased I_c, and that doping of 0.1-0.3 *Li* at% increased I_c by about 10%.

Other Cuprates

A mixed solid/vapor phase synthesis route for $HgBa_2CuO_{4+\delta}$ *(Hg-1201)* using a remote source of mercury has been developed by G. B. Peacock et al. (Birmingham). By this route, the authors were able to obtain a highly underdoped state ($T_c \leq 35$ K) of superconducting $HgBa_2CuO_{4+\delta}$.

As reported by A. Tampieri (Faenza) et al., $Hg_{1-x}M_xBa_2CuO_{4+\delta}$ (where x = 0 or 0.2 with *M* = *V* or *Pb*) compounds have been prepared by hot isostatic pressing (HIP) starting directly with simple oxides canned in a silver tube. The authors report that this is an effective way to prepare large amounts of *Hg-1201* superconductor with high purity.

High-resolution x-ray powder diffraction studies of the crystallographic phase transition from the orthorhombic (LTO1) phase to the low-temperature tetragonal (LTT) phase in $La_{1.88-y}Sr_{0.12}Nd_yCuO_4$ (y = 0, 0.1, 0.2, and 0.4) are reported by A. R. Moodenbaugh (Brookhaven) et al. The authors report that the development of the LTT phase is a two-step process.

As reported by Y. Cao et al. (TCSUH), the transition temperature T_c of the high-temperature superconductor $YSr_2Cu_3O_{7.5}$ has been measured under hydrostatic pressures up to 1.7 GPa. The T_c was observed to increase from 62.6 K to 67.8 K. The authors note that such a large positive dT_c/dP of ~3 K/GPa is unexpected, since thermogravimetric and thermopower measurements indicate that the sample is heavily doped.

Thin Films

A model, based only on universal properties of high-T_c superconductors, to account for the transport characteristics of grain boundaries in these materials is discussed in a preprint by H. Hilgenkamp and J. Mannhart (Augsburg). The model accounts for both the superconducting and normal-state transport properties observed in a comprehensive study of $YBa_2Cu_3O_{7-\delta}$ [001]-tilt bicrystalline grain boundaries with varying misorientation angles and of two different symmetries.

Thin-film and bulk [001] tilt, bicrystal grain boundaries in $YBa_2Cu_3O_{7-\delta}$ exhibit a strong dependence of the critical current density on misorientation angle. K. E. Gray et al. (Argonne) point out that what is particularly difficult to understand is that J_c is thirty times lower in bulk grain boundaries, which are microscopically more perfect, i.e., minimally faceted and free of impurity phases. The authors propose a plausible explanation based on differences of the pinning of Josephson vortices in the two grain-boundary types. They note that meandering of the grain boundary is desirable for biaxially textured coated-conductor applications to enhance J_c.

A preprint by J.-T. Kim (KRISS) et al. reports measurements of the in-plane longitudinal resistivities of $YBa_2Cu_3O_{7-\delta}$ films before and after *Sn* ion irradiation with matching field $B_\phi = 1$ T as a function of magnetic field H (≤ 6 T) and temperature T. Near the critical temperature, the fluctuation part of the conductivity $\sigma^*_{xx}(T,H)$ of the unirradiated sample was found to obey 3D XY scaling with dynamic critical exponent $z = 1.86 \pm 0.1$ and static critical exponent $\nu \approx 0.669$. The irradiated film deviates from 3D XY scaling, especially at low fields.

The angular dependence of the longitudinal and Hall resistivities of $YBa_2Cu_3O_{7-\delta}$ films with and without columnar defects has been studied by D. H. Kim (Yeungnam) et al. The Hall conductivity $|\sigma_{xy}|$ of an irradiated film shows a sharp increase with decreasing temperature when an external magnetic field is aligned parallel to the columnar defects, while $|\sigma_{xy}|$ of an unirradiated film shows a broad minimum in the same orientation. The Hall conductivity thus exhibits a strong pinning dependence.

A preprint by Y. Li and K. Tanabe (SRL-ISTEC) reports a study of the effects of target composition upon the properties of epitaxial $NdBa_2Cu_3O_{7-\delta}$ superconducting thin films deposited on $SrTiO_3$ (100), $LaAlO_3$ (100), and $NdGaO_3$ (110) substrates by pulsed laser deposition using slightly *Ba*-rich $Nd_{1-x}Ba_{2+x}Cu_3O_{7-\delta}$ (x = 0.00, 0.03, 0.05, and 0.10) targets. The highest zero-resistance transition temperature, 94 K, was obtained for x = 0.03. The critical current density J_c in a 1000 Å thick, 5 μm wide bridge was 3.8×10^6 A/cm^2 at 77 K in zero field. The authors report target and substrate optimization conditions for obtaining smooth, nearly outgrowth-free film surfaces.

Applications

The effect of a square array of holes (antidots) in the washer of a *YBCO* bicrystal rf SQUID upon the low-frequency (1/f) noise has been investigated by P. Selders et al. (Jülich). The authors found that the noise was greatly reduced at a set of magnetic fields that geometrically relate the vortex lattice and the antidot lattice well below the fundamental matching field $B_m = \phi_0/d^2$ (d = antidot lattice parameter).

The performance of a five-pole Tchebycheff microstrip low-pass filter (5.3 GHz cutoff frequency) made of a *YBCO* thin film grown on a $LaAlO_3$ substrate is reported in a paper by M. S. Boutboul et al. (LDIM, Paris). The average insertion loss and the rejection slope were found to be appreciably better with the superconducting filter than with a gold filter made using the same pattern. The performance of the *YBCO* filter remained approximately constant up to the transition temperature.

The underlying theory for the behavior of a mesoscopic SNS transistor is described in a preprint by F. K. Wilhelm (Karlsruhe) et al. In this device, the quasiparticle distribution can be driven far from equilibrium by a voltage applied across the normal metal. This reduces the supercurrent between the superconducting electrodes, which creates the possibility to use these SNS junctions as fast switches and transistors.

Theory

A theory that depends on competition between intertwin d-wave coupling and a relatively enhanced s-wave compo-

nent on the surface has been developed by R. Haslinger and R. Joynt (Wisconsin-Madison) to explain the existence of Josephson tunneling between $YBa_2Cu_3O_{7-\delta}$ and *Pb* with the current flowing along the *YBCO* c axis. The theory appears to explain, at least qualitatively, all observations made to date.

As shown by M. B. Walker and P. Pairor (Toronto), surface bound states in a discrete-lattice model of a $d_{x^2-y^2}$ cuprate superconductor are, in general, coherent superpositions of an incoming excitation and more than one outgoing excitation. The authors develop a graphical construction based on a surface Brillouin zone to describe these bound states. In addition, the authors explain the origin of a momentum-dependent lifetime contribution to the width of the bound states as observed in tunneling experiments.

The phase diagram for a 2D metal with variable carrier density has been studied by V. P. Gusynin (Kiev) et al. using the modulus-phase representation for the order parameter. This amounts to splitting the degrees of freedom into neutral fermions and charged boson degrees of freedom. The resulting phase diagram contains a new phase in addition to the superconducting (Berezinskii-Kosterlitz-Thouless) and normal (Fermi-liquid) phases. The authors identify this phase with the pseudogap phase observed in underdoped high-T_c superconductors above their critical temperature.

According to a preprint by E. A. Pashitskii (Kiev) et al., the square-root Van Hove singularity in the density of states $\nu(E_F) \sim (E_F - E_0)^{-1/2}$, associated with the extended saddle-point features in the electronic spectra of cuprates with hole-type conductivity, leads to a nonmonotonic dependence of the critical temperature T_c upon the position of the Fermi level E_F with respect to the bottom E_0 of the saddle. As a result of cancellation of the divergence of $\nu(E_F)$ in the electron-electron coupling constant, renormalized by strong-coupling effects, the authors show that T_c approaches zero in the limit $E_F \rightarrow E_0$, contrary to the result in the weak-coupling approximation, which gives a finite (and close to maximal) value of T_c for $E_F \rightarrow E_0$. The authors also find that the dependence of T_c on the concentration of doped holes, obtained in the strong-coupling approximation, agrees qualitatively with experimental data for the overdoped cuprates.

A single-particle spectral density is proposed by A. S. Alexandrov (Loughborough) for cuprates, taking into account bipolaron formation, realistic band structure, thermal fluctuations, and disorder. The author explains tunneling and photoemission (PES) spectra, including the temperature-independent gap observed in both the superconducting and normal states, the emission-injection asymmetry, the finite zero-bias conductance, the spectral shape in the gap region and its temperature and doping dependence, and dip-hump incoherent asymmetric features at high voltage (tunneling) and large binding energy (PES).

A microscopic model describing the combined effect of the Hund coupling and the local Coulomb repulsion on the ground-state properties of the layered perovskite compound Sr_2RuO_4 has been formulated by M. Cuoco et al. (Salerno). Considering that the properties of this compound are determined mainly by the electron dynamics in the RuO_2 planes, the authors performed an exact diagonalization on small planar RuO_2, RuO_4, and Ru_2O_7 clusters, using the Lanczos algorithm. The authors found that the minimum value of the Hund coupling J needed to have a local triplet spin state on each *Ru* atom is a rapidly decreasing function of the intra-orbital d-electron Coulomb repulsion U. From an analysis of the off-site spin-spin correlation function, the authors also found that Sr_2RuO_4 behaves as a paramagnetic metal, in agreement with the experiments.

Overviews

An extensive review of flux pinning in the high-temperature superconductors, focusing on $RBa_2Cu_3O_{7-\delta}$, has been prepared by H. W. Weber (Atominstitut-Wien). The author discusses the mixed-state phase diagram, weak versus strong pinning, experimental techniques, the fishtail effect, flux pinning by various kinds of pinning centers (artificial pinning centers, normal-conducting inclusions, extended planar defects, and radiation-induced defects), critical current densities and irreversibility lines, and field mapping and levitation forces (248 refs.).

A preprint by R. A. Klemm (Argonne) presents an overview of experiments that give evidence concerning the symmetry of the order parameter in the high-temperature superconductors. The author considers three classes of experiments: transport and thermodynamic measurements, angle-resolved photoemission spectroscopy (ARPES), and Josephson tunneling experiments. The author finds that the experiments are not consistent with one another and hence concludes that the symmetry of the order parameter in the high-temperature superconductors is still unknown (49 refs.).

Ph.D. Thesis

The Ph.D. thesis of H. S. Somal (Groningen) reports polarized angle-resolved infrared spectroscopy (PARIS) measurements in the high-temperature superconductors $La_{1.85}Sr_{0.15}CuO_4$ (T_c = 32 K), optimally doped $Tl_2Ba_2CuO_6$ (T_c = 85 K), overdoped $Tl_2Ba_2CuO_{6+\delta}$ (T_c = 30 K), $Bi_2Sr_2CuO_6$ (T_c = 12 K), and $Nd_{1.85}Ce_{0.15}CuO_4$ (23 K), probing both the ab-plane and c-axis electrodynamics. The predictions of the interlayer tunneling (ILT) model were found not to hold for the *Tl, Bi,* and *Nd* cuprates (159 refs.).

Contributed by John R. Clem

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TECHNOLOGY NEWS

(Also see Applications section of Nota Bene.)

This section describes progress in manufacturing, product development, and technology transfer in the high-T_C superconductivity field. Please send your contributions (product development information, news regarding technology transfer efforts, or any information you would like to share about your corporation or laboratory) to the editor.

Scientists at the National Research Institute for Metals (Tsukuba, Japan), in collaboration with colleagues at the Showa Electric Wire and Cable Co., Ltd. (SWCC), have developed a novel fabrication procedure for *Bi-2212/Ag* composite tapes aimed at improving their superconducting properties. The PAIR (Pre-Annealing and Intermediate Rolling) process is the combination of pre-annealing and subsequent intermediate rolling, and is performed prior to melt-solidification. By pre-annealing at 1133 K in oxygen (1 atm) and intermediate rolling with 25% deformation, PAIR-processed samples produced transport J_C(oxide) values (4.2 K, 10 T) exceeding 500,000 A/cm^2, which corresponds to J_C(conductor) values of 900 A/mm^2. Samples melt-solidified without the PAIR process have J_C(oxide) values of 300,000 A/cm^2. The enhancement of J_C is attributed to the microstructure with high grain alignment and uniformity, as well as the improvement in grain connectivity achieved by the PAIR process. For information, contact Kitaguchi Hitoshi, National Research Institute for Metals, 1-2-1, Sengen, Tsukuba 305-0047, Japan; phone +81-298-59-2329; fax +81-298-59-2301; e-mail hk@nrim.go.jp.

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A. S. Alexandrov, "Theory of Tunnelling Into and From Cuprates." Presented at the Workshop on Strongly Correlated Electrons, Tallahassee, Fla., March 12-14, 1998. Department of Physics, Loughborough University, Loughborough, Leicestershire LE11 3TU, UNITED KINGDOM; telephone +44 1509 228409; telefax +44 1509 223986; e-mail vvk20@cus.cam.ac.uk; preprint also available at cond-mat@xxx.lanl.gov (#9803127). 74.20.-z.

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S. S. Banerjee, N. G. Patil, S. Ramakrishnan, A. K. Grover, S. Bhattacharya, P. K. Mishra, G. Ravikumar, T. V. Chandrasekhar Rao, V. C. Sahni, M. J. Higgins, C. V. Tomy, G. Balakrishnan, and D. Mck. Paul, "Reentrant Peak Effect in an Anisotropic Superconductor 2H-$NbSe_2$: Role of Disorder." Report #TIFR/CM/98/202 (I). Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Mumbai 400 005, INDIA; e-mail satya@tifrc2.tifr.res.in; preprint also available at cond-mat@xxx.lanl.gov (#9803274). Key words: reentrance, peak effect curve, effect of disorder, 2H-$NbSe_2$. 74.60.-w; 74.25.Dw; 64.70.Dv.

M. T. Beal-Mond, "Discussion of Various Hybrid Pairings for Orthorhombic *YBCO* Compounds and Possible Experiments." To be published in Physica C (in press). Laboratoire de Physique des Solides, Université Paris-Sud, Bâtiment 510,

F-91405 Orsay Cedex, FRANCE. Key words: orthorhombic *YBCO* compounds, hybrid pairings, models.

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H. S. Somal, "Polarized Angle Resolved Infrared Spectroscopy of High Temperature Superconductors." Submitted as a Ph.D. thesis (University of Groningen). Contact D. van der Marel, Solid State Physics Laboratory, University of Groningen, Nijenborgh 4, 9747 AG Groningen, THE NETHERLANDS; telephone +31 50 363-7229 or -4826; telefax +31 50 363-4825; e-mail marel@phys.rug.nl.

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Harald W. Weber, "Flux Pinning." To be published in the Handbook on the Physics and Chemistry of Rare Earths, Special Volumes on High Temperature Rare Earth Superconductors, edited by K. A. Gschneidner, Jr., L. Eyring, and M. B. Maple. Atomic Institute of the Austrian Universities, Schüttelstrasse 115, A-1020 Vienna, AUSTRIA.

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Th. Zahner, R. Stierstorfer, R. Rössler, J. D. Pedarnig, D. Bäuerle, and H. Lengfellner, "Anisotropic Resistivity in Off-c-Axis Grown $Bi_2Sr_2CaCu_2O_8$ Films." To be published in Physica C (in press). Institut für Experimentelle und Angewandte Physik, Universität Regensburg, D-93040 Regensburg, GERMANY; fax +49 941 943 4223; e-mail thomas.zahner@physik.uni-regensburg.de. Key words: $Bi_2Sr_2CaCu_2O_8$, off-axis growth, anisotropic resistivity.

COMING EVENTS

*(An * indicates a previously listed event.)*

July 20 - 24, 1998: School on Mesoscopic Electronics, International Centre of Condensed Matter Physics, Universidade De Brasilia,

Brazil. Topics are: introduction to mesoscopic physics, Coulomb blockade, review of disordered mesoscopic physics experiments, chaotic transport in microstructures, thermodynamics of disordered mesoscopic systems, experiments in ballistic microstructures, nonlinear effects in mesoscopic transport, correlation effects in quantum dots, transfer matrix and DMPK equation, M-I transition and interaction effects. For further information, contact School on Mesoscopic Electronics, International Centre of Condensed Matter Physics, CP 04513 Campus Universitario Darcy Ribeiro, CEP 70919-970, Brazil-DF; e-mail meso@iccmp.br; Web site http://www.if.uerj.br/~caio/meso.html.

*Sept. 6 - 11, 1998:

Gordon Research Conference on Superconductivity: Cuprate Superconductors and Related Materials, Queen's College, Oxford, United Kingdom. Colin Gough and Bertram Batlogg, Co-Chairs; M. Brian Maple, Vice-Chair. Sessions are: recent theoretical developments, influence of pairing symmetry on properties, normal-state pseudogap, c-axis conduction, new materials, proximity coupling with CMR and other materials. For information, contact Gordon Research Conferences, University of Rhode Island, P.O. Box 984, West Kingston, RI 02892-0984; telephone (401) 783-4011; telefax (401) 783-7644; e-mail app@grcmail.grc.uri.edu (for application form requests) or grc@grcmail.grc.uri.edu (for general information).

Sept. 14 - 25, 1998:

NATO Advanced Study Institute – Material Science, Fundamental Properties and Future Electronic Applications of High-T_C Superconductors, Albena, Bulgaria. Purpose is to help young physicists in their initial research in the field of HTS and related topics, and to support creation of the atmosphere of collaboration between physicists from NATO and Cooperative Partner countries. Aimed at scientists at the postdoctoral level with an appropriate scientific background. Subjects include: electronic structure of novel superconductors and related materials, Fermi surface mapping by angle-resolved photoemission, d-wave superconductivity, application of Eliashberg theory, and anomalous normal-state properties of HTS. Special attention will be paid to classical problems in the physics of superconductivity: Ginzburg-Landau and London theories and their application to theory of plasma waves in superconducting systems, surface phase transitions, hydrodynamic relations for superconductors, dynamics and pinning of vortices in HTS, electrodynamics, magnetic susceptibility, optical properties, tunneling, fluctuation phenomena in superconductors. Will also include phenomenology of superconductivity: practical applications, superconducting field effect transistors, electric field effects in superconductors, and grain boundary and other material effects. **Application deadline, May 30, 1998.** For information, contact T. Mishonov, Department of Theoretical Physics, Faculty of Physics, University of Sofia, 5, J. Bourchier Blvd., 1164 Sofia, Bulgaria; telephone +359 2 256 652; telefax +359 2 96 252 76; e-mail mishonov@rose.phys.uni-sofia.bg.

Nov. 16 - 19, 1998:

11th International Symposium on Superconductivity (ISS'98), Fukuoka Sunpalace Hotel, Fukuoka, Japan. Organized by the International Superconductivity Technology Center (ISTEC). Symposium will consist of oral and poster sessions and invited talks in the following topics: Physics – theory, physical properties, and new measurement techniques; Chemistry – new materials and syntheses, substitution, solid-state chemistry, and properties; Critical Current – flux-pinning mechanism, vortex physics, and weak links; Wires, Tapes, and Bulk – solid-state powder ceramics, chemical-solution processing, melting solidification, and chemical-vapor deposition; Films and Junctions – processing, properties, lithography, junction fabrication, and physics; Device Applications – digital, analog, SQUID, and other electronic devices; System Applications – power, power transportation, magnets, magnetic shields, and other system applications; Standardization – standardization for electromagnetic, mechanical, and microwave properties measurements. Will also include exhibition of materials and devices. **Abstract deadline, June 30, 1998; exhibit application deadline, July 31, 1998.** Proceedings to be published. Official language is English. For further information, contact ISS'98 Secretariat, ISTEC, Eishin Kaihatsu Bldg. 6F, 34-3 Shimbashi 5-chome, Minato-ku, Tokyo 105-0004, Japan; telephone +81 3 3431-4002; telefax +81 3 3431-4044.

RESOURCES

Information

Proceedings:

High-Temperature Superconductivity: Ten Years After Its Discovery, proceedings of the International Workshop on High-Temperature Superconductivity, Jaipur, India (Dec. 16-21, 1996), edited by K. B. Garg and S. M. Bose. This volume reviews the progress in the high-T_C superconductivity field in the last ten years, and discusses future directions and the differences in viewpoints that need to be resolved. Issues discussed range from theories to microscopic and macroscopic applications. Publ. 1998; 437 pp.; price $25; ISBN 81-7319-155-7. For information, contact K. B. Garg, Condensed Matter Physics Laboratory, Department of Physics, University of Rajasthan, Jaipur - 302 004, India; telephone +91 141-519767; telefax +91 141-511912; e-mail krishna@jp1.vsnl.net.in. Or contact S. M. Bose, College of Arts and Sciences, Drexel University, Philadelphia, PA 19104; telephone (215) 895-2620 or -2718; telefax (215) 895-4999; e-mail bose@duvm.ocs.drexel.edu.

Proceedings:

M-Calc II – Proceedings of the Military and Commercial Applications of Low-Cost Cryocoolers (Jan. 15-16, 1998). Sponsored by the Electronic Industries Association (EIA) in cooperation from DARPA, NRL, and NVESD. For information, contact EIA ALCEM, Department 287, Washington, DC 20055; telephone (703) 907-7546; telefax (703) 907-7549; e-mail cryo@eia.org.

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High-T_C Update is the high-T_C superconductivity information exchange newsletter. It is available twice-monthly as hard copy and as electronic mail. Please send: 1) preprints, reprints, and other T_C-related reports or publications; 2) descriptions of on-going work; 3) meeting news; and 4) etc. Information in *High-T_C Update* is intended for limited distribution. Readers are expected to respect the rights of authors.