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HIGH T_c UPDATE

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Coated Conductors

As noted in a paper by A. Sheth et al. (University of Tennessee Space Institute), the recent achievements of critical current densities exceeding 10^6 A/cm^2 in *$YBa_2Cu_3O_{7-\delta}$ (YBCO)* deposited on suitably textured substrates have stimulated interest in developing coated conductors for potential applications at high temperatures (e.g., 77 K and above) and in high magnetic fields. Currently, ion-beam-assisted deposition (IBAD) and rolling-assisted biaxially textured substrates (RABiTS) are two of the most promising options for obtaining textured substrates. For applying suitable coatings of buffer layers and high-temperature superconducting (HTS) materials on textured substrates, many options are available, including sputtering, electron-beam evaporation, pulsed-laser deposition (PLD), electrophoresis, chemical vapor deposition (CVD), metal organics chemical vapor deposition (MOCVD), sol-gel, metal organics decomposition (MOD), electrodeposition, and aerosol/spray pyrolysis.

To carry out an engineering evaluation of the various candidate options, the authors developed process-flow schemes, identifying the major operating steps, process conditions, and process streams. Then, to evaluate quantifiable parameters such as temperature, pressure, coating thickness, HTS deposition rate, maximum achieved J_c, cost of chemicals, and material utilization efficiency, the authors used a multi-attribute method to determine attributes/merits for the various parameters and candidate options. To evaluate nonquantifiable parameters, the authors used a subjective evaluation. Finally, to calculate the overall merit/utility of a given option, the authors combined the above two evaluations using weighting factors.

Based on currently available information, the authors conclude from the above evaluations that the leading candidates for deposition of buffer layers and *YBCO* (HTS) are MOD and sol-gel, both of which are solution-growth techniques, and MOCVD and PLD, both of which are physical/vapor-phase growth techniques. All four of these options have achieved high critical current density (J_c) values in the range 10^5-10^6 A/cm^2 (77 K, self-field) on single-crystal substrates and thus have the potential for achieving similar values on textured metallic substrates. The authors note that as more work is done on different deposition routes, additional information will become available, and it is possible that their rankings may change.

The authors also point out a number of areas where additional research and development work is needed: cost of chemicals; mass transfer and reaction kinetics data; diagnostics and control; environmental issues; outer passivation/insulation layer; splice connections; corrosion, toxicity, and health hazards; and overall cost of production. For the latter item, the authors stress that an unbiased effort should be made with help from industrial partners to develop a realistic estimate of the overall cost of production.

$RBa_2Cu_3O_{7-\delta}$

SQUID susceptibility and NMR data on *Zn-* and *Ni*-substituted *$YBa_2Cu_3O_{6+x}$* are reported by P. Mendels (Orsay) et al. The authors were able to determine the magnetic susceptibility associated with the substituents from the underdoped to the lightly overdoped case. The Weiss temperature θ for *Zn* in *YBCO* was found to be very small (e.g., $\theta \approx 4.5$ K) for all hole doping levels n_h. Since in conventional metals the Kondo temperature obeys $T_K < \theta$, the authors note that magnetic screening effects are not expected for $T >> \theta$. Increasing n_h produces a reduction of the small moment induced by Zn^{2+} and a nearly constant effective moment for Ni^{2+}, corresponding to a spin 1/2 on *Ni* rather than spin 1.

The microwave absorption of untwinned and twinned crystals of *$YBa_2Cu_3O_{7-\delta}$* vs temperature near T_c has been measured by D. Shaltiel (Hebrew University) et al. in different magnetic fields **B**||c and **B**||ab. A good fit to the Tinkham model was obtained for the untwinned crystal for **B**||c and for B > 0.2 T, while for the twinned crystal, the authors observed pronounced deviations from the model, which they attribute to the presence of twin-boundary pinning. Although field-dependent resistivity measurements on the untwinned $YBa_2Cu_3O_{7-\delta}$ single crystal clearly demonstrate a vortex-lattice melting transition, these microwave studies showed no signature of this transition.

A preprint by W. H. Tang and J. Gao (Hong Kong) reports measurements indicating that *Pr* at *Y* and *Ba* sites in $YBa_2Cu_3O_{7-\delta}$ exhibit different T_c-depression behaviors. The depression of superconductivity by *Pr* at *Y* sites is due to both hole-filling and depairing effects, while that at *Ba* sites seems to be due solely to hole filling.

Bi Cuprates

A clear gap structure has been observed by Ya. G. Ponomarev (Moscow State) et al. in the current-voltage characteristics of stacks of n intrinsic S/I/S junctions in series (n ≤ 28) obtained in $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* using a break-junction technique. Because of the high resistance of the stacks, the bias voltages could be raised to well above the gap voltage V_{gn} without significant overheating. For samples with a critical temperature T_c = 84-89 K and $2\Delta/k_BT_c = 6.7\pm0.3$, the value of V_{gn} corresponding to a steep rise of the quasiparticle current is well described by the relation $V_{gn} = n(2\Delta/e)$ with a gap parameter Δ(4.2K) = (25±1) meV. The authors argue that the presence of a sharp gap feature in the current-voltage characteristics points to an essential contribution of s-wave pairing to the symmetry of the order parameter in *Bi-2212*.

Highly doped high-T_c *Bi* cuprates, such as $Bi_{2.2-x}Pb_xSr_{1.8}$-$CaCu_2O_{8+\delta}$ (x = 0.7) *[Bi(Pb)-2212],* recently have been found to have dramatically improved critical current density J_c. To examine the atomic structure of *Bi(Pb)-2212,* M. Nishiyama (Yokohama City University) et al. have performed ultrahigh vacuum scanning tunneling microscopy (UHV-STM) on these materials. The authors observed lamellar structures of α and β phases (lamella thicknesses ~ 20 nm); the α phase was modulated along b with $\lambda \approx 7$ nm, while the β phase had no modulation. Some lamellas of α phase showed fragmented modulation, as well as amorphous regions a few nanometers in size and edge dislocations with Burgers vector (1/2)[110]. The authors suggest that these defects could be effective pinning centers in *Bi(Pb)-2212.*

Structural changes during the annealing of a silver-clad monofilamentary $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ *[(Bi,Pb)-2223]* tape in air have been monitored *in situ* by H. F. Poulsen (Risø) et al. using synchrotron x-ray diffraction. Starting at 750°C, a very slow ramp rate was used, followed by high-temperature cycling to study equilibrium phenomena and kinetics. The authors monitored the concentration of the partial liquid; a *3321* phase dissolves below 790°C. Between 760°C and 820°C, the *2212* lattice parameters contract, indicating incorporation of *Pb* and/or *Ca*. At the same time, grain growth takes place, relieving strains. Between 820°C and 840°C, $(Ca,Sr)PbO_4$ dissolves and the amount of liquid increases. Conversion of *2212* to *2223* takes place at all temperatures above 820°C. Above 833°C, $(Ca,Sr)CuO_3$ appears. Cycling between 845°C and 860°C, where *2212* has almost disappeared, reveals fast, nearly reversible changes, indicative of several eutectics involving the *2212, 2223,* $(Ca,Sr)_2CuO_3$, and liquid phases. By cycling, the incorporated *Ca* and/or *Pb* is lost irreversibly. Cooling data are consistent with precipitation of *2212* and *2223* by layer-on-layer growth on the existing grains. The authors comment on growth models and make a comparison with similar annealing experiments at constant temperature.

Reactions occurring in *Ag*-sheathed monofilamentary *(Bi,Pb)-2223/Ag* tapes have been studied *in situ* by E. Giannini et al. (Geneva) using high-temperature neutron diffraction. A neutron-compatible furnace enabled the authors to anneal tapes under the same processing conditions as those used for standard high-performance monofilamentary tapes. The data were analyzed using a full-pattern profile refinement. Seven phases were simultaneously refined, so that it was possible to carry out a full quantitative analysis of secondary phases during the reaction thermal treatment. The steady conversion of *2212* into *2223* was quantified, and the structural transformations occurring in *2212* prior to its conversion into *2223* were carefully analyzed. The authors also determined the role of different *Pb*-rich phases, such as Ca_2PbO_4 and $Pb_3(Sr,Bi)_3Ca_2CuO_y$, at this stage of the reaction. The authors also observed and quantified the formation of $Sr_8Ca_6Cu_{24}O_{41}$ and *2201* at high temperatures. During slow cooling, a regrowth of *2212* was observed, which did not correspond to any decomposition of *(Bi,Pb)-2223*. At the same time, the decomposition of $Sr_8Ca_6Cu_{24}O_{41}$ and *2201* was observed, and the authors suggest that this phenomenon is related to the increase of *2212* upon cooling. Because the neutron-diffraction technique allows a direct measurement of the absolute amount of crystalline matter inside the sample, the authors were able to estimate the amount of amorphous matter present. This was found to vary with time and temperature, and its nonmonotonic evaluation indicates that melting and recrystallization occur over a wide time window at the early stages of the reaction.

The fabrication and characterization of multifilamentary *Ag*-clad *(Bi,Pb)-2223* superconducting tapes are discussed in a preprint by U. Balachandran (Argonne) et al. The authors found that the critical current decreased exponentially with field when an external magnetic field was applied perpendicular to the tape surface at 77 K. Mechanical stability was tested for tapes sheathed with pure *Ag* or with *Ag-Mg* alloy. Tapes made with pure *Ag* sheathing could withstand a tensile stress of ≈20 MPa with no detrimental effect on I_c. The mechanical properties improved with *Ag-Mg* alloy sheathing: Values of the transport critical current began to decrease only at a tensile stress of ≈100 MPa. Transport current measurements on tapes wound on a mandrel of diameter 3.81 cm at 30° to the longitudinal axis showed a reduction of ≈10% in I_c values for pure *Ag*-sheathed tapes and a reduction of 5% for *Ag-Mg*-sheathed tapes, relative to the values for as-coiled tapes.

Other Cuprates

Angular-dependent torque-magnetization measurements have been performed by J. Hofer (Zürich) et al. on a $HgBa_2CuO_{4+\delta}$ *(Hg-1201)* microcrystal close to the critical temperature T_c. The authors analyzed the results in terms of critical fluctuation theory using 3D XY scaling. In a finite magnetic field, the torque on the sample was found to be given by a universal scaling function dG(z)/dz, where the scaling argument z depends on temperature, field, and the angle between the field and the sample's c axis.

Hall-coefficient measurements, thermogravimetric analysis, and Mössbauer spectroscopy by Y. Li (Rio de Janeiro) et al. indicate that *Fe* dopants in $Tl_{0.5}Pb_{0.5}(Sr_{0.8}Ba_{0.2})_2Ca_2(Cu_{1-x}Fe_x)_3O_y$ *[(Tl,Pb)-1223]* not only destroy the integrity of the CuO_2 planes but also induce extra oxygen in the lattice to localize carriers. For *Fe* doping levels in the range x = 0-0.05, the authors found that both the zero-resistance transition temperature T_c and the Hall carrier concentration n_H decrease linearly with x.

Films

A detailed study of pulsed-laser deposition (PLD) of high-T_c compounds onto unheated substrates, which results in amorphous thin films preserving the composition of matter ejected from the target, has been carried out by V. D. Okunev (Donetsk) et al. The results enabled the authors to learn about the dynamics of laser-target interactions for both on-axis and off-axis deposition.

Micro-Raman studies of thin *YBCO* films deposited by PLD on yttria-stabilized zirconia *(YSZ)* (001) substrates have been carried out by M. S. Chen et al. (Singapore). The authors found evidence for the formation of a $BaZrO_3$ transitional layer at the *YBCO/YSZ* interface.

The effect of microwave current on the parameters of *YBCO* thin films deposited on $LaAlO_3$ has been investigated by T. Nurgaliev et al. (Sofia) at 77 K and 4.23 GHz using a microstrip resonator technique. Approximate expressions for the hysteretic loss contributions to the HTS film surface resistance were obtained and used to interpret the dependence of the surface resistance upon the amplitude of the microwave current.

To explore the idea that weak links are responsible for the power dependence of the surface impedance of high-T_c thin films, D. E. Oates (MIT Lincoln Lab) et al. have measured and modeled the microwave impedance of fabricated Josephson junctions. The authors report evidence for Josephson-vortex creation and annihilation by the microwave currents.

Studies of light-induced changes in the electrical properties of *YBCO* grain-boundary Josephson weak links are reported by R. Adam (Rochester) et al. The authors report that high-intensity laser modification of these junctions led to improved electrical characteristics that remained unchanged after subsequent room-temperature/helium-temperature thermal cycling. The laser-modified junctions exhibited up to a 25% increase in the I_cR_n product (critical current times normal-state resistance).

The effects of electromigration of basal-plane oxygen vacancies on $YBCO/YBa_2Cu_{2.79}Co_{0.21}O_{7-\delta}/YBCO$ (SNS) ramp-edge Josephson junctions have been studied by J. P. Sydow (Cornell) et al. Through the application of a 4-10 mA (~2-5 MA/cm^2) current bias at room temperature, the basal-plane oxygen order and content in the N and S layers were improved. This was demonstrated by an increase in I_cR_n from <5 μV to as much as 205 μV. The authors discuss the implications of these results on SNS junction fabrication and the nature of tunneling in such devices.

A preprint by G. A. Alvarez et al. (SRL-ISTEC) reports on high-quality planar junctions fabricated from well-characterized c-axis quasi-homoepitaxial $NdBa_2Cu_3O_{7-\delta}/PrBa_2Cu_3O_{7-\delta}/NdBa_2Cu_3O_{7-\delta}$ *(NBCO/PBCO/NBCO)* multilayers. Evidence is found in c-axis tunneling spectroscopy for the quasiparticle tunneling that is commonly observed for superconductor/insulator/superconductor (SIS) junctions. The authors observed a temperature-dependent BCS-like gap with $2\Delta/k_BT_c = 6$. The tunneling conductance dI/dV of the junctions in parallel magnetic fields shows an anomalous splitting of the quasiparticle density of states, which can be related to the magnetic moment of the quasiparticles.

Magnetic measurements have been performed by H. A. Radovan and P. Ziemann (Ulm) on a ring-patterned $[YBa_2Cu_3O_{7-\delta}]_{56\,Å}/[PrBa_2Cu_3O_{7-\delta}]_{125\,Å}$ superlattice with a transition temperature of T_c = 69 K. Using this geometry, the authors were able to obtain the critical current density J_c(T), current-voltage characteristics E(J), and magnetization hysteresis M(H). The authors report evidence for a crossover from 3D to 2D collective pinning with increasing temperature T.

Applications

Magnetocardiography (MCG) measurements have been carried out by Y. Zhang (Jülich) et al. using HTS rf washer SQUIDs with coplanar resonators. MCG measurements on the same healthy subject were performed with a magnetometer in the Berlin magnetically shielded room, and with a first-order gradiometer in a standard shielded room in Jülich. The results were compared with respect to the fragmentation score, which is a risk marker for sudden cardiac death. Despite the different environments, the score values determined with the magnetometer and the gradiometer were almost identical.

As noted by C. P. Foley et al. (CSIRO), thin-film HTS SQUIDs operated at 77 K and exposed to weak magnetic fields exhibit significant excess low-frequency noise arising from thermally activated hopping of vortices trapped in the superconducting film. The authors report an investigation of the dependence of this phenomenon on SQUID design and fabrication, measurement conditions, and magnetic-field history. For example, the authors found that the method of cooling the SQUID strongly affected the level of excess noise, with cooling in the magnetic field in which the SQUID was to be operated being preferable to zero-field cooling.

The origin of 1/f voltage noise in different types of Josephson junctions fabricated from high-temperature superconductors (HTS) has been studied by A. Marx et al. (Köln). The authors find that this is due to the trapping and release of charge carriers in trapping centers in an insulating barrier, giving rise to correlated fluctuations of the junction critical current I_c and normal-state resistance R_n. A linear scaling with R_n has been observed for the normalized fluctuations S_I and S_R, suggesting an almost constant density of trapping centers for all investigated HTS Josephson junctions. Using this linear scaling, the authors have estimated the density of trapping centers.

The noise and Josephson mixing properties of HTS Josephson junctions have been studied by O. Harnack (Jülich) et al. The authors report the results of direct radiation measurements and heterodyne mixing experiments in the frequency range 45-141 GHz using *YBCO* step-edge junctions on *$LaAlO_3$* and *MgO* substrates, and bicrystal junctions on *MgO* substrates.

As noted in a preprint by B. Ruck et al. (Jülich), of all Josephson digital logic circuits, RSFQ (rapid-single-flux-quantum) logic seems to be the most promising because of high operating speed and low power dissipation. Complex RSFQ circuits already have been tested using *$Nb/AlO_x/Nb$* junctions. In this paper, the authors report that they have produced and examined all basic elements, such as superconducting crossovers, vias, pinhole-free insulation layers, and on-chip resistors, that are necessary to design and fabricate HTS *(YBCO)* RSFQ circuits. All structures have been successfully tested and integrated with ramp-type junctions with *PBCO* barriers. Using this technology, the authors fabricated a simple multilayer circuit consisting of two magnetically coupled dc SQUIDs. The circuit allowed essential operations, including generating, erasing, and detecting a single flux quantum. One dc SQUID served as the storage loop, while the other, kept permanently in the voltage state, was used to determine the internal flux state of the storage loop.

A high-T_c superconducting sampler circuit based on ramp-edge junctions and an upper-layer ground plane has been designed and measured by M. Hidaka et al. (NEC). While means were found to operate the sampler circuit at 50 K, the authors report that more work is needed to reduce the effect of parasitic inductance in the circuit.

The construction of a cavity resonator using single-domain *YBCO* processed by the seeded-melt-growth (SMG) method is reported by D. Qu (Cincinnati) et al. The cavity, which operates in the TM_{010} mode, consists of a hollow cylindrical cup (inside diameter 13.57 mm and height 2.75 mm) covered by a polished plate. All cavity parts were made of single-domain *YBCO* without any dielectric materials. At 18.4 GHz, the unloaded Q was 10,200 at 35 K and about 2,000 at 77 K. The authors assert that single-domain HTS cavities show considerable promise for rf applications.

A simple, inexpensive technique for the measurement of energy losses in HTS tape carrying ac currents in ac magnetic fields at liquid-nitrogen temperature is reported in a preprint by S. P. Ashworth and M. Suenaga (Brookhaven). The method, based on measuring the temperature rise of a thermally insulated tape, is currently able to measure losses down to 0.01 W/m. The authors show that data obtained using this method are in agreement with previously published results for electrically measured losses at 100 Hz due to in-phase ac currents and magnetic fields. Using the calorimetric method, the authors also have measured the losses as a function of the phase difference between the current and field.

As reported by T. Verhaege (Alcatel) et al., the European project SUPERPOLI is investigating the use of superconductors in medium-voltage/high-current power transmission over short distances, e.g., in generator out-lines and at particular points of distribution grids. Superconductors provide the capability of fault-current limitation, as well as strong reductions of Joule losses and the costs of civil engineering. A three-phase 1 GVA prototype is under consideration; its design will be aided by realization and test of a one-phase 20 kV/2 kA demonstrator. Two families of superconductors will be investigated: Melt-cast processed tubes of *Bi-2212,* linked by flexible conductors, are a rapid and robust solution, while coated conductors of ion-beam-deposited *YBCO* on a stainless steel substrate promise eventually to offer the best level of performance.

Theory

A preprint by M. Berciu and S. John (Toronto) evaluates from first principles the self-consistent Hartree-Fock energies for multi-soliton configurations in a doped spin-1/2 antiferromagnetic Mott insulator on a two-dimensional square lattice. The microscopic Hamiltonian for this system involves a nearest-neighbor electron hopping matrix element t, an on-site Coulomb repulsion U, and a nearest-neighbor Coulomb repulsion V. The authors find that nearest-neighbor Coulomb repulsion on the energy scale of t stabilizes a regime of charged meron-antimeron vortex soliton pairs over a region of doping from 0.05 to 0.4 holes per site for intermediate coupling, $3 \le U/t \le 8$. This stabilization is mediated through the generation of spin-flux in the mean-field antiferromagnetic (AFM) background. Spin-flux is a form of spontaneous symmetry breaking in a strongly correlated electron system in which the Hamiltonian acquires a term with the symmetry of spin-orbit coupling at the mean-field level. This leads to a physical picture of the normal state in which charge carriers are engulfed by vortex solitons in the AFM background. The resulting liquid of charged bosons is a non-Fermi liquid with a strong pairing interaction between charged vortices having opposite winding numbers. The authors show that this theory explains three independent experiments: magnetic neutron scattering, mid-infrared optical absorption, and some aspects of angle-resolved photoemission spectroscopy (ARPES), as well as providing a solution for the 1/8 doping problem in accordance with the Tranquada configuration. This is accomplished with one free fitting parameter.

As noted in a preprint by M. R. Norman (Argonne), a defining property of metals is the existence of a Fermi surface, which in two dimensions is a continuous contour in momentum space that separates occupied from unoccupied states. The author discusses angle-resolved photoemission spectroscopy (ARPES) data for the cuprate superconductor *Bi-2212* and argues that it is best not to think in terms of this conventional picture. Rather, the data are consistent with Fermi patches of finite area connected by more conventional Fermi arcs. The patches exhibit novel physics: the states in a patch are dispersionless and thus interaction-dominated. In the pseudogap phase, the patches are gapped out, leaving the Fermi arcs disconnected. The author suggests that this picture may be the key to understanding the microscopic physics in the high-temperature superconductors, in that the pairing correlations are strongest in the patches, yet the superfluid density lives only on the arcs.

The optical conductivity along and perpendicular to the CuO_2 planes (σ_{xx} and σ_{zz}) has been calculated by D. van der Marel (Groningen), who assumed strong $k_{||}$ dependence of the scattering rate and the c-axis hopping parameter. The author shows that the closed analytical expressions for $\sigma_{xx}(\omega)$ and $\sigma_{zz}(\omega)$ are integrable at low and high frequencies. Qualitatively different frequency dependencies are found for the two polarizations. The expression for $\sigma_{xx}(\omega)$ has an effective scattering rate proportional to frequency, and it can be generalized to provide a simple analytical expression that may replace the Drude formula for non-Fermi liquids.

The ground state and first excited state of two interacting superconducting layers have been studied by M. Grigorescu (Western Ontario) considering two different coupling terms, one being the standard Josephson interaction and the other being a new superexchange pairing force between bilayer pairs. The author shows that a moderate to strong Josephson interaction produces a low-lying collective state, pictured as an out-of-phase oscillation of the BCS gauge angles of the two layers. This antisymmetric angular oscillation might explain the 41 meV resonance observed in neutron-scattering experiments.

A generic Hamiltonian incorporating the effect of orbital contraction on the hopping amplitude between the nearest sites has been studied by H. Boyaci (Bilkent) and I. O. Kulik (Bilkent and Kharkov) analytically in the weak-coupling limit and numerically (for finite atomic clusters) in the intermediate- and strong-coupling regimes. The authors determined the range of parameters for which the Cooper instability occurs. They also found that the Hubbard model with $U > 0$ does not show any sign of superconductivity in small clusters.

A numerically exact diagonalization study on small insulating clusters of the t-J model with second- and third-neighbor hopping terms (t-t'-t"-J model) has been carried out by T. Tohyama (Tohoku) et al. The authors find that a spin-liquid state is realized around a doped hole with momentum $\mathbf{k} = (\pi,0)$ and energy ~2J, where the spin and charge degrees of freedom are approximately decoupled. This result implies that the excitations in the insulating cuprates are mapped onto the d-wave RVB state.

The role of the Coulomb interaction in superconductivity has been considered by J. D. Fan and Y. M. Malozovksy (Southern University and A&M College). The authors find that only in the particle-hole channel does the BCS Hamiltonian have the BCS solution for an attractive interaction, whereas in the particle-particle channel the interaction is still repulsive. The authors' approach to a layered 2D system leads to a metal-superconductor transition with a possibly high transition temperature T_c, but they find that in an isotropic 3D system this transition can never exhibit a high T_c.

As noted in a preprint by A. S. Alexandrov (Loughborough), in the boson-fermion model (BFM), the self-energy of bosons hybridized with fermions prevents Cooper pairing of fermions via virtual transitions into unoccupied bosonic states. The author stresses that this self-energy catastrophe rules out the BFM as a phenomenological model of superconductivity. According to the author, previous publications concluding that the BFM is a high-temperature superconductor were in error because of an incorrect treatment of the boson self-energy, neglect of the Pauli principle, or violation of the energy-conservation law. The author asserts that the superconducting critical temperature is actually determined by the Bose-Einstein condensation of intrinsically mobile bipolarons rather than by the hybridization of immobile pairs with mobile fermions.

The thermal depinning of vortex lines along the irreversibility line has been investigated by T. Matsushita (Kyushu Institute of Technology and Kyushu University) and T. Kiss (Kyushu University) using the coherent potential approximation, in which the effect of thermal activation is handled by making the pinning potential shallow. In this approach, thermal depinning becomes a transition of second order, and the degree of disorder of the vortex lattice decreases as the temperature increases.

Other Activities

A preprint by J. L. González (Rio de Janeiro and Havana) et al. theoretically analyzes experimental configurations commonly used to measure the c-axis and in-plane resistivities (ρ_c and ρ_{ab}) in high-T_c superconductors and then recommends the arrangements to use for the most accurate measurements of ρ_c and ρ_{ab}.

The superconductor-insulator transition of ultrathin films of *Bi,* grown on liquid-helium-cooled substrates has been studied by N. Markovic et al. (Minnesota). The transition was tuned by changing both film thickness and perpendicular magnetic field. Assuming that the transition is controlled by a T = 0 critical point, the authors carried out a finite-size scaling analysis to determine the correlation-length exponent ν and the dynamical critical exponent z. The authors studied the phase diagram and critical resistance as a function of film thickness and magnetic field, and they discuss the results in terms of bosonic models of the superconductor-insulator transition, as well as percolation models, which predict finite dissipation at T = 0.

Results of transport measurements in the quantum critical regime of the disorder-tuned 2D superconductor-insulator transition (SIT) in homogeneously disordered *Bi/Sb* films are reported by J. A. Chervenak and J. M. Valles, Jr. (Brown). The authors find that as the superconducting transition temperature decreases, the transition width grows and appears to diverge at the SIT. In addition, structure develops in the dc current-voltage characteristics of films closest to the SIT, indicating that the 2D superconductivity is driven into a regime of extreme inhomogeneity. The data suggest a picture of the phase transition in which large amplitude fluctuations occur as the disorder suppresses the amplitude to near zero.

Overviews

As noted in an overview by M. Leghissa et al. (Siemens), superconducting cables can help provide electric power in densely populated areas in an economic and environmentally friendly way. High-temperature superconducting (HTS) cables now can be built with higher transmission capacities, smaller cross sections, and lower transmission losses. In this paper, the authors review basic properties of superconducting cables, discuss the status of the Siemens cable project, and outline the future prospects for HTS power transmission cables (25 refs.).

A brief survey of applications of high-temperature superconductors in magnetic bearings and flywheels has been prepared by K. B. Ma (TCSUH). The author includes a description of hybrid HTS magnetic bearings, which combine the advantages of large levitation forces possible between permanent magnets with the stability provided by HTS material between them (5 refs.).

Contributed by John R. Clem

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Roman Adam, Roman Sobolewski, Wilhelm Markowitsch, Christian Stockinger, and Wolfgang Lang, "Optically Induced Effects in *Y-Ba-Cu-O* Josephson Junctions." To be published in Appl. Supercond. (in press). Contact Roman Sobolewski, Department of Electrical Engineering and Laboratory for Laser Energetics, University of Rochester, P.O. Box 270231, Rochester, NY 14627-0231; telephone (716) 275-1551; telefax (716) 275-2073; e-mail roman@ee.rochester.edu.

A. S. Alexandrov, "Self-Energy of the Boson-Fermion Model of High-Temperature Superconductors." To be published in Physica C (in press). Department of Physics, Loughborough University, Loughborough Leicestershire LE11 3TU, UNITED KINGDOM; phone +44 01509 223303; fax +44 01509 223986; e-mail asa21@cus.cam.ac.uk. Key words: boson-fermion model (BFM), Bose-Einstein condensation (BEC), critical temperature. 74.20.-z; 74.60.-w.

G. A Alvarez, T. Utagawa, and Y. Enomoto, "c-Axis Tunneling and Magnetic Field Splitting of the Quasi-particle States in Planar $NdBa_2Cu_3O_{7-\delta}/PrBa_2Cu_3O_{7-\delta}/NdBa_2Cu_3O_{7-\delta}$ Quasi-Homostructures." To be published in Appl. Supercond. (in press). Superconductivity Research Laboratory, International Superconductivity Technology Center (ISTEC), 10-13 Shinonome 1-chome, Koto-ku, Tokyo 135, JAPAN; telephone +81 3 3536-5703 through -5705; telefax +81 3 3536-5714 or -5717.

S. P. Ashworth and M. Suenaga, "The Calorimetric Measurement of Losses in HTS Tapes Due to ac Magnetic Fields and Transport Currents." To be published in Physica C (in press). Contact M. Suenaga, Materials Science Division, Brookhaven National Laboratory, P.O. Box 5000, Upton, NY 11973-5000; telephone (516) 344-3518; telefax (516) 344-4071; e-mail mas@sun2.bnl.gov. Key words: calorimetric measurement, HTS tapes, magnetic fields, transport currents.

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COMING EVENTS

*(An * indicates a previously listed event. Also see complete listing of upcoming conferences and workshops at our Web site http://www.iitap.iastate.edu/htcu/comevents.html.)*

July 4 - 8, 1999: Gordon Research Conference on Chemistry of Electronic Materials, New England College, Henniker, New Hampshire. Topics will include organic electronic materials, low-K materials, optoelectronics, nano-electronic materials, frontiers of electronic materials, etching, and defining and surpassing the horizon of electronic materials. To apply, contact Gordon Research Conferences, University of Rhode Island, P.O. Box 984, West Kingston, RI 02892-0984; telephone (401) 783-7644; telefax (401) 783-4011; e-mail appl@grcmailgrc.uri.edu; Web site http://www.grc.uri.edu.

Sept. 18 - 24, 1999:* First Euroconference on Vortex Matter in Superconductors, Aghia Pelagia, Crete, Greece. Topics will include nano-engineered pinning arrays – regular and disordered, vortex visualization, vortex matter at extreme conditions, vortices in mesoscopic superconductors, Josephson vortices, vortex dynamics, driven vortex lattices, melting, vortices in superfluids, plasma, etc. Limited to 120 participants. **Abstract deadline, May 31, 1999; registration deadline, June 30, 1999. For more information, contact V. V. Moshchalkov, Katholieke Universiteit Leuven, Laboratorium voor Vaste-Stoffysica en Magnetisme, Celestijnenlaan 200 D, B-3001 Leuven (Heverlee), Belgium; telephone +32 16 327618; telefax +32 16 327983; e-mail Victor.Moshchalkov@fys.kuleuven.ac.be; Web site http://www.fys.kuleuven.ac.be/vortex/.

Sept. 26 - Oct. 2, 1999: The 16th International Conference on Magnet Technology (MT-16), Sawgrass Marriott Resort, Ponte Vedra Beach, Fla. Conference will bring together approximately 500 scientists, engineers, and experts from around the world to focus on the latest developments in technology, operation, applications of research and industrial magnets, and magnet materials. Program will focus on topics such as magnets for accelerators and fusion as well as generation of high fields, including superconducting, resistive, pulse, and permanent magnets. Special session to be devoted to HTS magnets with major emphasis on industrial applications, such as magnets for NMR and MRI, energy storage, levitation, and separation. Several sessions will be dedicated to new developments in high- and low-temperature superconductors and other magnet materials for reinforcement, impregnation, and insulation. Meeting will combine technological and scientific aspects of magnet technology including basic investigations involving magnet materials, electrodynamics, stability of superconductors, heat transfer, *He-II* cooling, cryogenics, etc. System optimization, magnet analysis, design strategies, new instrumentation, and related issues will also be included. **Abstract deadline, June 15, 1999; pre-registration deadline, August 15, 1999.** For information, contact Jo Ann Palmer, Conference Secretary, National High Magnetic Field Laboratory, 1800 E. Paul Dirac Drive, Tallahassee, FL 32310; telephone (850) 644-1933; telefax (850) 644-9462; e-mail mt16@magnet.fsu.edu; Web site http://www.magnet.fsu.edu/mt16/.

Nov. 1 - 5, 1999:

9th Workshop on rf Superconductivity, La Fonda Hotel, Downtown Santa Fe, New Mexico. Brings together over 200 contributors from dozens of laboratories and industries around the world. Workshop will cover the status of, and advances in, rf superconductivity; field emission in niobium cavities; fabrication, cleaning, and surface preparation; rf power delivery; topical reviews related to materials used in superconducting cavity fabrication; and future applications of superconducting technology. **Abstract deadline, September 1, 1999; pre-registration deadline, June 15, 1999.** For more information, contact Lorraine Stanford, Los Alamos National Laboratory, P.O. Box 1663, MS H845, Los Alamos, NM 87545; telephone (505) 667-5051; telefax (505) 667-9409; e-mail rfsc99@lanl.gov; Web site http://mesa53.lanl.gov/rfsc99/.

**Feb. 20 - Feb. 25, 2000:*

6th International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors (M^2S-HTSC-VI), George R. Brown Convention Center, Houston, Texas. Hosted by the Texas Center for Superconductivity at the University of Houston and sponsored by federal agencies and industry. Co-Chairs: C. W. Chu, W. K. Chu, and K. Salama. This series of meetings, established in 1988, two years after the discovery of high-temperature superconductors, is dedicated to superconductivity and related phenomena, and the host materials of these phenomena. The Conference will bring together members of the international low- and high-temperature superconductivity community to focus on recent insights into low- and high-temperature superconductor physics, materials, and devices. Emerging areas and future trends will also be highlighted. General conference topics include, but are not limited to, experimental and theoretical studies of Superconducting Materials – low temperature, high temperature, fullerite, heavy fermion, organic, new; Physical Properties – mechanisms, magnetic, electrical, optical, thermal, mechanical, acoustic; Synthesis and Processing – thin films, superlattices, thick films, bulk; and Applications – small current (SQUIDs, junctions, microwave devices) and large current (cables, transformers, motors, generators, magnetic levitation devices). **Abstract deadline, September 15, 1999.** For information, contact M^2S-HTSC-VI Conference Secretariat, Texas Center for Superconductivity, University of Houston, 3201 Cullen Boulevard, Houston, TX 77204-5932; telefax (713) 743-8216; Web site http://m2s-conf.uh.edu.

March 31 - April 10, 2000:

Conference on Major Trends in Superconductivity in the New Millennium (MTSC 2000) and Symposium on Itinerant and Localized States in HTSC (SILS), Klosters, Kanton Graubünden, Switzerland. The scope of MTSC 2000 is on recent developments and trends in new superconducting systems with emphasis on experiments and theories which are relevant to the pairing mechanism. Besides the superconducting cuprates, conventional superconductors, organic systems, borocarbides, ruthenates, nanostructures, and fullerenes will be addressed. In order to raise the awareness for novel ideas and results in this rapidly growing field, the physics and chemistry of related materials will be included. Special emphasis will be on phenomena related to nanoscale phase separation and charge modulation. The symposium on Itinerant and Localized States in HTSC is organized by K. A. Müller and E. Kaldis (Zürich, Switzerland). MTSC 2000 is organized in close analogy to the Gordon conferences. There will be a limited number of slots for posters. The total number of participants is limited to 130 persons. Proceedings will be published in a special issue of *Journal of Superconductivity.* **Pre-registration deadline, November, 15, 1999.** For more information, see Web site http://www.mpi-stuttgart.mpg.de/CONF/mtsc2000.html.

RESOURCES

Information

New Book:

Non-equilibrium Processing of Materials, Pergamon Materials Series 2, edited by C. Suryanarayana. The rapid technological developments during the latter half of the 20th century have demanded materials that are stronger, capable of use at much higher temperatures, more corrosion-resistant, and much less expensive than those currently used. This book discusses several new processing technologies that have been developed during the past few decades including rapid solidification, spray forming, mechanical alloying, ion mixing, vapor deposition, laser processing, and plasma processing. Book chapters, written by world-recognized experts in their respective fields, describe the principles, processing techniques, special features of the materials produced, and their applications. Extensive list of references provided at the end of each chapter to facilitate location of additional information on specific aspects of any technique. Intended for graduate students of materials science and engineering, and scientists wishing to enter this area of research.

Publ. 1999; 446 pages; price NLG 284.00 (euro 128.87) or US $144.00; ISBN 0-08-042697-2. For information, contact Elsevier Science, Regional Sales Office, Customer Support Department, New York, NY 10159-0945; telephone (212) 633-3730 or (888) 437-4636 (for North-American customers); telefax (212) 633-3680; e-mail usinfo-f@elsevier.com.

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