HIGH T_c UPDATE

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NOTA BENE:

Surface Resistance

Two papers listed in this issue describe the development and applications of scanning near-field microwave (50 MHz - 50 GHz) microscopes that operate at temperatures from 4.2 K to room temperature and image electrodynamic properties of films in both superconducting and normal states on length scales down to about 2 μm. S. M. Anlage et al. (Maryland) describe such a microscope and report its use to obtain images of (a) the sheet resistance of a *$YBa_2Cu_3O_{7-\delta}$ (YBCO)* thin-film wafer, (b) bulk *Nb* surfaces, (c) T_c of a *$YBa_2Cu_3O_{7-\delta}$* thin film, and (d) local properties in patterned thin-film devices. A. S. Thanawalla (Maryland) et al. describe the use of an open-ended coaxial probe with a 200 μm inner conductor diameter, which can operate from 77 K to 200 K in the 10 MHz - 20 GHz frequency range, to image the electric-field distribution above a *$Tl_2Ba_2CaCu_2O_{8+\delta}$ (Tl-2212)* microstrip resonator (resonant frequency 8.2 GHz) at 77 K, measured at several heights. The authors also describe the use of a frequency-following circuit to study the influence of the probe on the resonant frequency of the device.

The 10 GHz surface resistance has been measured by N. Bontemps et al. (Ecole Normale Supérieure) in *$Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi-2212)* single crystals in the 50-85 K temperature range. The measurements probed the dissipation associated with currents flowing both within the ab plane and along the c axis. Depending upon the static field orientation θ with respect to the layers, the authors were able to identify and characterize the contributions of different kinds of vortices (Josephson or pancake vortices) through their microwave absorption properties.

Measurements of the temperature and field dependence of the radio-frequency (rf) penetration depth λ(H,T) in oriented platelets of *$(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ [(Bi,Pb)-2223]* are reported by S. Patnaik (IIT-Kanpur) et al. The authors found critical fields H_1* and H_2* at which the dynamics changes from grain-boundary-dominated to bulk-pinning-dominated and from bulk-pinning dominated to flux flow, and identified these fields as H_{c1} of the grains and the irreversibility field, respectively. The authors also used this technique to detect the trapping of magnetic flux in grain boundaries.

A preprint by M. Ausloos (Liège) presents a theoretical discussion of the intrinsic effects of a dc magnetic field B upon the real (R_s) and imaginary (X_s) parts of the microwave surface impedance of superconductors. The author presents predicted power-law dependencies of R_s and X_s upon B for s- and d-wave superconductors. Since the published data are not always in agreement with the predicted power laws, the author suggests that this indicates the presence of extrinsic effects, such as granularity and weak links.

A preprint by P. Raychaudhuri (IIT-Kharagpur) and V. V. Srinivasu (TIFR-Mumbai) reports the observation of anomalous oscillations and hysteresis in the surface resistance at 77 K in *Bi-2212* bulk samples as the applied dc magnetic field increased from zero to 1000 Oe and then decreased back to zero. The authors explain the oscillations by considering the sample as a network of Josephson junctions and loops, and they attribute the observed hysteresis to flux trapping in the network.

ac Losses

Formulae for the eddy-current ac power loss and the ac hysteresis loss of z-stacks and x-arrays made of metal-superconducting strips are presented in a paper by K.-H. Müller (CSIRO). The author examines the ac losses in self-field (transport losses) and in an applied ac magnetic field for different stacking spacings of a z-stack and different lateral spacings of an x-array. The author evaluated the losses numerically and found that at 50 Hz the eddy-current loss in a z-stack or an x-array made of *YBCO*/Hastelloy tapes is much smaller than the hysteresis loss, while in a z-stack or x-array made of monofilamentary *Bi-2223/Ag* tapes the eddy-current loss contributes significantly at small current or small magnetic field amplitudes.

Various factors influencing the ac losses in multilayer cables consisting of many superconducting tapes are considered in a preprint by A. M. Campbell (IRC-Cambridge). The author considers such factors as the cable impedance, hysteresis losses, silver losses, the effect of barriers, helical conductors, the current-transfer length, the continuum model, and the effect of the other two phases in a three-phase cable.

Vortices

The longitudinal and Hall voltages have been measured by G. D'Anna (EPFL-Lausanne) et al. in a clean twinned $YBa_2Cu_3O_{7-\delta}$ single crystal in the liquid and solid vortex phases. For magnetic fields tilted away from the c axis by more than about 2°, a scaling law $|\rho_{xy}| = A\rho_{xx}^{\beta}$ with $\beta \approx 1.4$ was observed, which was unaffected by the vortex-lattice melting transition. For magnetic fields aligned parallel to the c axis, however, the twin-boundary correlated disorder modified the scaling law, giving $\beta \approx 2$. The scaling law was unaffected by the Bose-glass transition.

Magnetoresistance measurements of the effects of 9 MeV proton irradiation on a clean, untwinned single crystal of $YBa_2Cu_3O_{7-\delta}$ are reported by A. M. Petrean (Western Michigan and Argonne) et al. Before irradiation, the authors observed the first-order vortex-melting transition. After proton irradiation, which produces point-like disorder, the authors found evidence for a second-order vortex-glass transition. The results suggest that a sufficiently high defect density is required for the vortex-glass phase to be observed.

High-resolution specific-heat measurements along the vortex-melting line in $RBa_2Cu_3O_{7-\delta}$ *(R = Y, Dy,* and *Eu)* crystals are reported by M. Roulin et al. (Genève) in magnetic fields up to 16 T parallel to the c axis. Depending upon the magnitude of the magnetic field and the quality of the crystal, the authors observed the first-order vortex-melting transition, the Bose-glass transition, or the vortex-glass transition.

Measurements of the Nernst effect (flux-flow voltage induced by a temperature gradient) in magnetic fields up to 4 T along the c axis in textured *Bi-2223* have been used by M. Pekala (Warsaw) and M. Ausloos (Liège) to determine the vortex-lattice melting line $B_M(T)$. The authors measured the Nernst voltage N vs. temperature T at different fields B, and obtained the melting line from the temperatures at which changes in the slope dN/dT occurred.

Three preprints listed in this issue report on various features of vortex flow extracted from simulations. A. P. Mehta et al. (Michigan) note that river basins as diverse as the Nile, the Amazon, and the Mississippi satisfy certain topological invariants known as Horton's laws. From analysis of the morphology and statistical properties of networks resulting from flux-gradient-driven vortex flow in superconductors containing a random distribution of pinning centers, the authors derive a phase diagram (on the plane of pinning force vs. vortex density) of different network morphologies, including one in which Horton's laws relating length and stream number are obeyed.

A dynamic phase diagram (on the plane of vortex-vortex interaction strength vs. driving force) obtained by C. J. Olson et al. (Michigan) indicates that at least two dynamic phases of flux flow appear, depending upon the vortex-vortex interaction strength. When the vortex lattice is soft, the vortices flow in independently moving channels with smectic structure. For stiff vortex lattices, adjacent channels become locked together, producing crystalline-like order in a coupled-channel phase. The system produces maximum voltage noise at the crossover between these two phases.

Using numerical simulations, C. Reichhardt and F. Nori (Michigan) have observed phase locking, Arnold tongues, and Devil's staircases for vortex lattices driven at varying angles with respect to an underlying periodic pinning array. For most of the results presented, N_v, the number of vortices, is close to N_p, the number of pinning sites: $N_v = 1.062\ N_p$. The transverse V(I) (voltage vs. current, or velocity vs. driving force) curves have a Devil's staircase structure, with plateaus occurring when the driving angles are along symmetry directions of the pinning array. Each of the plateaus corresponds to a different dynamical phase with a distinctive vortex structure and flow pattern.

Using the diagrammatic functional method for the effective action, S. Grundberg and J. Rammer (Umeå) have developed a self-consistent mean-field theory for the dynamic melting transition of a driven vortex lattice. The results corroborate the phase diagram (on the plane of driving force vs. temperature) predicted by the phenomenological shaking theory, and the obtained melting curve is in good quantitative agreement with both the phenomenological theory and simulations.

A preprint by A. V. Nikulov (Chernogolovka) argues that the concept of vortex-lattice melting in the mixed state of type-II superconductors is "science fiction" based on incorrect notions about the Abrikosov state and incorrect definitions of phase coherence. To explain the resistive properties of superconductors with strong disorder, the author suggests a return to the Mendelssohn sponge model [K. Mendelssohn, *Proc. Roy. Soc.* **152A**, 34 (1935)].

$RBa_2Cu_3O_{7-\delta}$

As reported by K. Segawa and Y. Ando (CRIEPI), the in-plane normal-state resistivity of *Zn*-doped $YBa_2Cu_3O_{7-\delta}$

single crystals has been measured to low temperatures by suppressing superconductivity with magnetic fields up to 18 T. Substitution of *Cu* by *Zn* in the CuO_2 planes was found to induce carrier localization at low temperatures in clean samples with $k_F\ell > 5$, where since the mean free path ℓ is larger than the electron wavelength, localization is not normally expected. The authors suggest destruction of the local antiferromagnetic correlation among *Cu* spins by *Zn* as a possible origin of this unusual charge localization.

Measurements by A. N. Lavrov et al. (Novosibirsk) of the out-of-plane resistivity ρ_c of heavily underdoped $RBa_2Cu_3O_{6+x}$ (*R = Tm* and *Lu)* single crystals show that the c-axis conductivity σ_c contains two contributions. One of these is the familiar semiconductor-like conductivity usually observed in moderately underdoped samples. The other looks metal-like and dominates the interplane transport at low temperatures and low doping, where the *CuO* chains are destroyed. Because of this contribution, the resistivity anisotropy ρ_c/ρ_{ab} saturates at low T instead of diverging. The metal-like part of σ_c is blocked by antiferromagnetic coupling.

As reported by V. N. Narozhnyi (Troitsk and Dresden) et al., in *Al*-free $PrBa_2Cu_3O_{7-\delta}$ single crystals, the kink in the temperature dependence of the magnetic susceptibility χ_{ab}(T) connected with *Pr* antiferromagnetic ordering disappears after field cooling (FC) in a field **H**||ab. However, the kink in χ_c(T) remains unchanged after FC in **H**||c. The authors suggest an explanation in terms of magnetic coupling between the *Pr* and *Cu(2)* sublattices, in which antiferromagnetic ordering in the Pr^{3+} sublattice is suppressed by freezing of the *Cu* moments in the ab plane after FC in **H**||ab.

YBCO bulk materials have been crystallized by P. Schätzle et al. (Dresden) using a multi-seeded melt-growth process. Up to four biaxially oriented *Sm-123* seeds were placed on top of rectangular *YBCO* bars (up to $100 \times 40 \times 15$ mm^3). The resulting grains of *YBCO* were joined by partially coherent grain boundaries with improved current-transport capability and high levitation forces.

Entrapped spherical pores occur in $YBa_2Cu_3O_{7-\delta}$ crystals melt-textured without additives. However, C.-J. Kim (KAERI) et al. report that the pores entrapped within *Y-123* crystals melt-textured with 5 wt% $BaCeO_3$ are elongated and aligned parallel to the (100), (010), and (001) growth planes of the *Y-123* crystals.

A microscopic description of grain boundaries in $YBa_2Cu_3O_{7-\delta}$ is given in two papers by S. V. Stolbov et al. (TCSUH). In the first paper, the authors carried out electronic structure calculations for several fragments of grain boundaries, and they found that the number of broken *Cu-O* bonds in the CuO_2 plane at the interface affects the local density $N_{Cu}(0)$ of d_{Cu}-electron states at the Fermi level. In the second paper, the authors use spin-fluctuation theory, in which $N_{Cu}(0)$ controls the superconductivity, to estimate the superconducting properties of grain boundaries in *YBCO* and *BSCCO*.

Two papers by M. K. Mironova et al. (TCSUH) report transmission electron microscopy (TEM) studies shedding light on why grain boundaries in melt-textured *YBCO* formed by the liquid-phase-removal method (LPRM) carry high currents and do not show a strong dependence on misorientation angle.

A new approach to the preparation of biaxially textured *YBCO* coated tape conductors is proposed by M. Staines et al. (IRL-Lower Hutt). Using a dynamic magnetic grain-alignment technique, a biaxially aligned dispersion of orthorhombic *Y-247* powder is settled on untextured silver substrates. In a subsequent heat treatment, the *Y-247* is transformed to *Y-123* and *CuO* involving a partial melt. Critical current densities at 77 K in self-field of up to 5 kA/cm^2 have been obtained in films from 10 to 30 μm thick, showing a clear enhancement of J_c relative to identically prepared untextured or uniaxially textured samples. J_c appears to be limited at present by the difficulty of achieving fully densified films while retaining biaxial texture. The authors note that, provided significant improvements in J_c can be obtained, this method offers an alternative to coated-tape processes based on epitaxial growth. The new method does not demand textured substrates, and it can give much higher fill factors.

Bi Cuprates

The effect of preparation of precursor powders on the formation of *Bi-2223* phase and the critical current density J_c of oxide-powder-in-tube (OPIT) tapes has been studied by A. Polasek et al. (Rio). The precursors were prepared by one-powder and two-powder methods. The authors found that tapes prepared from one-powder precursor had double the J_c of the tapes made from two-powder precursors.

A preprint by X. L. Wang et al. (Wollongong) reports observations by optical microscopy and x-ray diffraction of the growth mechanism of *Bi-2212* and *Bi-2201* crystals grown at the surface of *KCl* flux. The authors found that the growth of *Bi-2212* crystals is typically spiral-mediated, while *Bi-2201* crystals grow layer-by-layer. The *Bi-2212* crystals grown on a *KCl* surface were soft and could be bent freely, while no softening was observed for the *Bi-2201* crystals. TEM studies revealed abundant dislocation networks in the softened *Bi-2212* crystals.

Measurements of the low-amplitude ac susceptibility of intact and deformed *Bi-2223/Ag* tapes are reported by P. N. Mikheenko (Wollongong) as a function of temperature, frequency, ac amplitude, and dc magnetic field. The deformation resulted in the splitting of the χ"(T) peak into three peaks situated near 30 K, 58 K, and 90 K. The author identifies these temperatures as the Kosterlitz-Thouless temperatures of low-number stacks of superconducting layers.

Borocarbides

The Hall resistivity ρ_{xy} of polycrystalline $LuNi_2B_2C$ has been measured by V. N. Narozhnyi (Troitsk, Dresden, and Wroclaw) et al. and found to be negative in both the normal and mixed states, and thus not to have the sign reversal that is typical for high-T_c superconductors. The authors found a distinct nonlinearity in the dependence of ρ_{xy} upon magnetic field in the normal state for $T \leq 40$ K, and a large magneto-resistance reaching 90% for $\mu_0 H = 16$ T at T = 20 K. The scaling relation $\rho_{xy} \propto \rho_{xx}^{\beta}$ (where ρ_{xx} is the longitudinal resistivity) was found in the mixed state, with the value of β depending on the degree of disorder (β = 2.0±0.1 for an annealed sample and 1.7±0.1 for an unannealed sample).

Applications

A hybrid superconductor-magnet bearing system, based on passive magnetic levitation and the flux-pinning effect of high-temperature superconductivity, has been developed by E. J. Lee (TCSUH and NASA Johnson Space Center) et al. The rationale lies in the unique capability of high-temperature superconductors to adapt to the low temperatures and vacuum environments in space or on the moon, and to enhance system stability passively without power consumption. The authors report characterization experiments, which show that the present hybrid HTS-magnet bearing system has small periodic oscillations of drag torque. The authors suggest design guidelines for future superconducting bearing systems.

Theory

The evolution of the 41 meV resonance seen in inelastic neutron-scattering experiments in optimally doped $YBa_2Cu_3O_{7-\delta}$ has been studied by J. Brinckmann and P. A. Lee (MIT) using slave-boson theory for the t-t'-J model. The resonance appears in this theory as a collective spin fluctuation in the d-wave superconducting state. It is undamped at optimal doping because of a threshold in the excitation energies of particle-hole pairs with relative wave vector (π,π). When hole filling is reduced, the resonance moves to lower energies and broadens. Below the resonance energy, the authors find a crossover to an incommensurate response, in agreement with a recent experiment on $YBa_2Cu_3O_{6.6}$. The authors show that dynamic nesting in the d-wave superconducting state causes this effect.

The spatial variation of the order parameter near the surface of a d-wave superconductor has been calculated self-consistently by J.-X. Zhu (TCSUH) et al. using an extended Hubbard model. The authors find that a d + is order parameter can be induced near a {110} surface, leading to splitting of the zero-energy peak in the surface local density of states and the generation of a spontaneous surface supercurrent. This splitting can be diminished by increases of orthorhombicity, on-site repulsive interaction, or temperature. The results give a microscopic explanation for the surface broken-time-reversal-symmetry pairing state.

The temperature dependencies of the specific heat and spin susceptibility of a coupled $d_{x^2-y^2} + id_{xy}$ superconductor in the presence of a weak d_{xy} component have been investigated by A. Ghosh and S. K. Adhikari (São Paulo) using the tight-binding model on a square lattice and on a lattice with orthorhombic distortion. As the temperature is lowered below the critical temperature T_c, first a less ordered $d_{x^2-y^2}$ superconductor is created, which changes to a more ordered $d_{x^2-y^2} + id_{xy}$ superconductor at T_{c1} ($<T_c$). This behavior is evidenced by two second-order phase transitions with two corresponding specific-heat jumps at T_c and T_{c1}. The temperature dependencies of the superconducting observables exhibit a change from power-law to exponential as the temperature is lowered below T_{c1}.

The symmetry operations of the crystal groups relevant for the high-temperature superconductors $HgBa_2CuO_{4+\delta}$ *(Hg-1201),* $YBa_2Cu_3O_{7-\delta}$ *(Y-123),* and $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)*, as well as the allowable combinations of superconducting order parameter components, have been worked out by R. A. Klemm (Argonne) et al. The authors then evaluate the Josephson critical current I_c across c-axis twist junctions in the vicinity of T_c as a function of twist angle ϕ for each allowable order-parameter combination. The authors find that recent measurements of $I_c(\phi)$ by Q. Li et al. in *Bi-2212* are consistent with an order parameter containing an s-wave component, but inconsistent with one containing a $d_{x^2-y^2}$ component. The authors propose an improved tricrystal experiment.

A preprint by A. S. Alexandrov and R. T. Giles (Loughborough) shows that bipolaron formation leads to a d-wave Bose-Einstein condensate in cuprates. The authors find that it is the bipolaron energy dispersion rather than a particular pairing interaction that is responsible for the d-wave symmetry. The authors also explain the unusual low-temperature dependence of the penetration depth λ(T) in terms of the localization of bosons in the random potential. Both linear positive and negative slopes of λ(T) can occur, depending upon the random field profile.

Both large-U and small-U orbitals have been used by J. Ashkenazi (Miami) to study the electronic structure of the high-T_c cuprates. A striped structure with three types of carriers are induced: polaron-like stripons, which carry charge; quasielectrons, which carry both charge and spin; and svivons, which carry spin and lattice distortion. The author derives anomalous physical properties of the cuprates, including the behavior of the resistivity, Hall constant, and thermoelectric power. In this model, transitions between pair states of quasielectrons and stripons drive high-temperature superconductivity.

The problem of the crossover from BCS superconductivity to Bose-Einstein condensation in three dimensions has been considered by P. Pieri and G. C. Strinati (Camerino) for a system of fermions with an attractive, suitably regularized point-contact interaction. The authors include the contributions of a new class of diagrams to obtain a formulation that describes both the weak- and strong-coupling limits, and consequently results in an improved interpolation scheme for the intermediate (crossover) region.

The effect of static fluctuations in the phase of the order parameter on the normal and superconducting properties of a 2D system with attractive four-fermion interaction has been studied by V. P. Gusynin (Kiev) et al. The results show that as the temperature increases through the 2D critical temperature, the quasiparticle peaks broaden significantly, while the gap in the quasiparticle spectrum remains. The authors make use of this effect to explain the pseudogap behavior observed in high-T_c superconductors.

The correlation-driven transition from a paramagnetic metal to a paramagnetic Mott-Hubbard insulator has been studied by M. Potthoff and W. Nolting (Berlin) using the half-filled Hubbard model for thin-film geometry with d layers. Using the dynamical mean-field theory, the authors map the film problem onto a set of d single-impurity Anderson models, which are indirectly coupled via the respective baths of conduction electrons. The authors solve these impurity models at zero temperature using the exact-diagonalization algorithm.

Using the calculated electron energy band structure of $Tl_2Ba_2CuO_{6+\delta}$ *(Tl-2201),* A. Dragulescu (Maryland) et al. have computed the dependence of the c-axis magnetoresistance on the orientation of the magnetic field for different magnitudes of the magnetic field. The authors explain the known experimental results for the in-plane rotation of the magnetic field and predict the shape of the magnetoresistance oscillations for the out-of-plane rotations of the magnetic field. The authors show how the latter oscillations can be used to reconstruct the shape of the Fermi surface and to study the coherence of interplane electron tunneling. The authors conclude that earlier observations of angular magnetoresistance oscillations (AMRO) demonstrate that the interplane electron motion is coherent in *Tl-2201.*

A microscopic theory of organic superconductors based on the concept of partial electron dielectrization has been developed by A. Surana (Bhilwara) et al. The authors derive self-consistent equations for the superconducting order parameter Δ and dielectric order parameter D, and they apply the theory to explain experimental results in the 2D organic superconductor κ-$(BEDT\text{-}TTF)_2Cu(NCS)_2$. The model accounts for the coexistence of a spin-density-wave (SDW) state and superconductivity.

Other Activities

Two preprints by T. H. Johansen (Oslo) present solutions to the flux-pinning-induced magnetostriction (stresses and strains) in long type-II superconductors placed in a parallel magnetic field. One of these presents solutions for a long circular cylinder, and the other for a long rectangular slab. All stress and strain components are expressed in terms of the flux-density profile in the sample, and the results apply for any critical-state model of $J_c(B)$ vs B. The author emphasizes the behavior in decreasing magnetic fields, which generate tensile stresses that can lead to cracking of the sample.

Measurements of the in-plane thermal conductivity $\kappa(T,B)$ of superconducting crystals of $YBa_2Cu_3O_{7-\delta}$ *(Y-123),* $YBa_2Cu_4O_8$ *(Y-124),* and $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* as a function of temperature (10 K $\le$ T $\le$ 150 K) and magnetic field (B $\le$ 9 T) for different orientations of the magnetic field (**B**||c and **B**$\perp$c) are reported by A. N. Taldenkov et al. (Leipzig). The authors found that κ depends on B even above the critical temperature because of the contribution of superconducting fluctuations. They also found for a *Bi-2212* crystal that κ increases with field for **B**$\perp$c and T < 20 K.

Overviews

A book chapter summarizing the present knowledge about the nature of defects and microstructural processes in melt-textured $RBa_2Cu_3O_{7-\delta}$ (*R-123, R* = rare earth) superconductors has been prepared by F. Sandiumenge (Barcelona) and J. Rabier (Poitiers). The authors note that while some principles learned from *Y-123* can be applied to other *R-123* compounds, the discovery of *Nd-123* has dramatically widened the scope of microstructural studies in the *123* system. Future challenges include (a) optimization of interfacial flux pinning in melt-textured *Nd-123,* (b) control of the distribution and properties of antisite defects, (c) building of 3D dislocation substructures through *R* cation substitutions and deformation processing, and (d) exploration of new low-temperature deformation routes (131 refs.).

A brief introduction to the high-temperature superconducting oxides is given in a preprint by D. Pavuna (EPFL-Lausanne).

The author emphasizes that these materials are: (a) highly anisotropic layered oxides dominated by the properties of the CuO_2 planes, (b) quasi-two-dimensional doped insulators with an anomalous normal state, (c) superconductors with T_c ~ 100 K, and (d) extreme type-II superconductors with short coherence lengths (ξ ~ a few Å) and large penetration depths (λ ~ 2000 Å) (13 refs.).

Ph.D. Thesis

Investigations of substitution effects and magnetic properties of various high-temperature superconductors in the *R-Ba-Cu-O* family are reported in the Ph.D. thesis of G. Böttger (ETH-Zürich). The author used elastic and inelastic neutron scattering, x-ray diffraction, magnetic susceptibility, and specific-heat measurements to study the pseudogap in $HoBa_2Cu_4O_8$ *(Ho-124)* and $Er_2Ba_4Cu_7O_{15-\delta}$ *(Er-247), Ca* doping in $RBa_2Cu_3O_{7-\delta}$ *(R-123, R = Y* and *Er),* and magnetic ordering of the rare-earth ions in $R_2Ba_4Cu_7O_{15-\delta}$ *(R-247, R = Er* and *Dy)* (144 refs.).

Contributed by John R. Clem

Contents:

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A. S. Alexandrov and R. T. Giles, "d-Wave Bose-Einstein Condensation and the London Penetration Depth in Superconducting Cuprates." Submitted to Phys. Rev. Lett. Department of Physics, Loughborough University, Loughborough LE11 3TU, UNITED KINGDOM; R. T. Gile's telephone +44 1509-223315 or -228409; telefax +44 1509-223986; e-mail r.t.giles@lboro.ac.uk; preprint also available at cond-mat@xxx.lanl.gov (#9811270). 74.20.-z; 74.20.Mn.

M. K. Aliev, G. R. Alimov, I. Kholbaev, L. I. Leonyuk, T. M. Muminov, B. A. Olimov, R. F. Rumi, and H. I. Turkmenov, "Magnetically and Thermally Modulated Microwave Absorption in $Y_1Ba_2Cu_3O_{7-x}$ Single Crystal Near T_c." Contact G. R. Alimov, Institute of Applied Physics, Tashkent State University, 700095 Tashkent, UZBEKISTAN; e-mail gleb@iaph.silk.org; preprint also available at cond-mat@xxx.lanl.gov (#9810004). Key words: temperature modulation, magnetic-field modulation, superconducting transition, microwave absorption, high-T_c superconductor.

R. P. Aloysius, A. Sobha, P. Guruswamy, K.G.K. Warrier, and U. Syamaprasad, "Optimization of Tape Width and Powder Packing Density in the Powder-in-Tube Processing of *(Bi,Pb)-2223* Tapes." To be published in Physica C (in press). Contact U. Syamaprasad, Regional Research Laboratory (CSIR), Trivandrum 695 019, INDIA; telefax +91 471 491712; e-mail smail@csrrltrd.ren.nic.in. Key words: *(Bi,Pb)-2223/Ag* tapes, tape width, packing density, core density, critical current density. 74.72.Hs; 85.25.Kx.

Steven M. Anlage, D. E. Steinhauer, C. P. Vlahacos, B. J. Feenstra, A. S. Thanawalla, Wensheng Hu, Sudeep K. Dutta, and F. C. Wellstood, "Superconducting Material Diagnostics Using a Scanning Near-Field Microwave Microscope." To be published in IEEE Trans. Appl. Supercond.: Proc. of the 1998 Appl. Supercond. Conf. (ASC), Palm Desert, Calif., Sept. 13-18, 1998. Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, MD 20742-4111; B. J. Feenstra's telephone (301) 405-6132; telefax (301) 314-9541; e-mail feenstra@squid.umd.edu; preprint also available at cond-mat@xxx.lanl.gov (#9811158).

J. Ashkenazi, "Stripes, Electron-Like and Polaron-Like Carriers, and High-T_c in the Cuprates." To be published in J. Supercond. Department of Physics, University of Miami, P.O. Box 248046, Coral Gables, FL 33124; e-mail ashkenazi@phyvax.ir.miami.edu; preprint also available at cond-mat@xxx.lanl.gov (#9811261). Key words: high-T_c superconductivity, stripes, transport properties, mechanism.

M. Ausloos, "The Intrinsic Effects of a Magnetic Field on the Microwave Properties of s- or d-Order Parameter Symmetry High T_c Superconductors." To be published in Supercond. Sci. & Technol. SUPRAS, Institute of Physics, University of Liège, B5 Sart Tilman, B-4000 Liège, BELGIUM; e-mail ausloos@gw.unipc.ulg.ac.be; Web site http://www.phe.ulg.ac.be/. 74.25.Nf; 74.60.Ec; 72.10.-d.

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COMING EVENTS

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

**May 18 - 21, 1999:* International Magnetics Conference (INTERMAG 99), Hotel Hyundai, Kyongju, Korea. Purpose is to provide a forum for presentation of new developments in applied magnetics, magnetic phenomena and materials, and information storage techniques. Will include sessions on superconductivity, magnetic levitation and propulsion, and microwave and millimeter-wave applications. For information, contact INTERMAG 99, The Korean Magnetics Society, Rm. 905, The Korea Science and Technology Center, Yeoksam-dong 635-4, Kangnam-ku, Seoul 135-703, Korea; telephone +82 2 967 0518; e-mail intermag@kistmail.kist.re.kr; Web site http://intermag99.kist.re.kr/.

July 7 - 10, 1999:* Ninth International Workshop on Critical Currents (IWCC9-99), University of Wisconsin, Madison, Wisconsin. IWCC9-99 will be the ninth in a series of workshops devoted to study and discussion of the critical current density in superconductors. This three and one-half day workshop will be organized around keynote talks on flux pinning, grain-boundary properties, and the current-limiting mechanisms of single- and polycrystalline superconductors. Extensive discussion time will be given to these key topics. **Abstract deadline, January 31, 1999. For further information, contact M. M. Adams, Conference Coordinator, 1500 Engineering Drive, Room 917 ERB, Madison, WI 53706; telephone (608) 263-5029; telefax (608) 263-1087; e-mail iwcc@engr.wisc.edu.

**July 12 - 16, 1999:* Cryogenic Engineering Conference & International Cryogenic Materials Conference (CEC/ICMC), Hotel Inter-Continental Montreal, Montreal, Quebec, Canada. The CEC focuses on the science and engineering required for cryogenic applications such as liquefied gases for fuels; space applications of cryogenic liquids; cooling and performance of superconducting magnet systems in medical, transportation, power, and basic research applications; as well as the systems, machinery, control technology, and thermodynamics required to produce low temperatures. The ICMC focuses on the development, characterization, fabrication, and optimization of the materials used in cryogenic applications, typically broken into two broad categories: structural materials and superconducting materials. ICMC contributions cover both high- and low-temperature superconducting materials from basic materials research through behavior of composite cables and wires in applications. Cryogenic structural materials cover a broad range, including nonmetallic composites, polymeric resins and insulation materials, ferrous alloys, nickel-base alloys, aluminum alloys, and specialized materials for advanced cryocooler applications. For information, contact Centennial Conferences, Suite A-112, 4800 Baseline Road, Boulder, CO 80303; telephone (303) 499-2299; telefax (303) 499-2599; e-mail centennial@orci.com; Web site http://www.cec-icmc.org.

July 17 - 25, 1999:* 5th International Summer School and Scientific Workshop, Eger, Hungary. Organized by the SuperTech Consortium, Hungary. The objective of the Workshop is to provide an overview on the basic and up-to-date information on the theories and newest results both in fundamental research and applications of high temperature superconductors. The main framework of the School is a series of tutorial lectures, each of two-hour duration, presented by well-known scientists and experts. The lectures will be published in textbook form, and in addition, proceedings (containing the lectures and the papers of the conference, videos from the lectures, and the social programs) will be available on a CD-ROM. Round-table sessions to be organized after lectures for free discussion. Last two days of the School will be devoted to a scientific conference for participants willing to present results of their work. **Abstract deadline, March 1, 1999. For more information, contact Istán Vajda, Department of Electrical Machines and Drives, Technical University of Budapest, Egry József u. 18., H-1111 Budapest, Hungary; telephone +36 1 463 2961; telefax +36 1 463 3600; e-mail vajda@ntb.bme.hu.

August 17 - 20, 1999: 1999 Taiwan International Conference on Superconductivity (TICS'99) & 6th Workshop on Low Temperature Physics (WLTP6), Kenting, Taiwan, ROC. Continuation of the five previous TICS conferences. Topics are: superconducting materials (new, bulk, single crystal, and thin film); material characterization and physical properties; theories and applications of superconductivity; strongly correlated electron systems; and other low temperature physics-related topics. All papers will be refereed and published in the Chinese Journal of Physics (Taipei) as a special issue. Conference language is English. **Abstract deadline, May 1, 1999; preregistration deadline, April 1, 1999.** For information, contact Department of Physics, National Sun Yat-Sen University, Kaohsiung, Taiwan 804, Republic of China; telephone +886 7 5253701; telefax +886 7 5253709; e-mail ics99@mail.phys.nsysu.edu.tw; Web site http://www2.nsysu.edu.tw/Physics/tics99.

Sept. 14 - 17, 1999:* Fourth European Conference on Applied Superconductivity (EUCAS'99), Melia Gran Sitges, Hotel in Sitges, Barcelona, Catalonia, Spain. Aim is to provide a forum for presentation and discussion of the developments in the field of the applications of superconductivity, in both large and small scale, including the most recent advances in the subject. All aspects of applied superconductivity will be covered, from both a scientific point of view (which include contributions from the fields of physics, electronics, material properties, chemistry, and engineering), and also an industrial perspective. Conference will encourage new cooperation on European and wider international levels. The program will be divided into two main sections. Large Scale & Power Applications will include fusion and SMES, detectors and accelerators, fault current limiters, motors and generators, high magnetic fields, wires and cables, materials related to large-scale applications, system aspects, and other applications. Small Scale & Electronic Applications will include Josephson Junctions, SQUIDs, digital applications, mixers/detectors, passive devices, oscillators and volt standards, materials related to superconducting electronics, system aspects, and other applications. **Abstract deadline, March 15, 1999. For further information, contact Xavier Obradors, Institut de Ciencia de Materials de Barcelona (ICMAB-CSIC), Campus de la UAB, E-08193 Bellaterra (Barcelona), Catalonia, Spain; phone +34 93 580 18 53; fax +34 93 580 57 29; e-mail eucas99@icmab.es; Web site http://www.icmab.es/eucas99.

FYI

(High-T_C Update takes no responsibility for want ads listed in this section.)

Position Available: A talented and resourceful experimentalist with a Ph.D. in physics is sought to fill a Postdoctoral Research Associate position at the University of Maryland. Work will involve development of quantum computers using superconducting devices. The ideal applicant will have experience with millikelvin techniques and the operation and fabrication of thin-film superconducting devices such as SQUIDs. A good understanding of quantum mechanics and the ability to lead graduate students is required. To apply, mail a hard-copy CV and the names of three references to Prof. C. J. Lobb, Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, MD 20742-4111.

Position Available: A postdoctoral position is available at the Dipartimento di Scienze Fisiche "E.R. Caianiello," University of Salerno, Italy, to join a program of research on theoretical analysis of highly correlated electron systems. The applicant must have experience in methods of quantum field theory applied to condensed-matter physics, superconductivity, magnetism, and phenomenology of high-T_C cuprates. Programming experience in Fortran is required. Date of availability: January 1999 (negotiable); duration: one year, with a second-year extension possibility; salary: 20.000.000 Italian Lira per annum; job requirement: Ph.D. in condensed-matter physics; age requirement: must be younger than 32 years old. A formal application must be sent within one month to the Rector of the University of Salerno. Prospective candidates are invited to request formal application form, and send an informal application (including CV and list of publications) to Prof. F. Mancini, Dipartimento di Scienze Fisiche "E.R. Caianiello," Universita degli Studi di Salerno, Via S. Allende, I-84081 Baronissi (SA), Italy; telephone +39 089 965322; telefax +39 089 965275; e-mail mancini@vaxsa.csied.unisa.it.

Position Available: A two-year NRC Postdoctoral Research Associateship is available at the National Institute of Standards and Technology, Gaithersburg, Maryland. Position is open for the study of the magnetic structure of alloys, ferromagnetic resonance, magnetic domain imaging, Mössbauer effect spectroscopy, magnetic properties of high-T_C superconducting oxides, artificially modulated alloys, micromagnetic modeling, multicomponent nanocrystalline materials, and magnetic engineering. Candidates must be U.S. citizens and must have possessed a Ph.D. for less than five years at the time of application. Stipend: $48,500 + an annual allocation of $5,500. **Application deadline, January 15, 1999; date of availability, September 1999.** Contact Dr. Robert Shull, Leader, Magnetic Materials Group, National Institute of Standards and Technology, Gaithersburg, MD 20899-8552; telephone (301) 975-6035; e-mail robert.shull@nist.gov.

The High-T_C Update Web Site!

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