HIGH T_c UPDATE

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NOTA BENE:

READERS: Please remember that the main purpose of the newsletter is to make information available about PRE-PRINTS, not REPRINTS. It would be greatly appreciated, therefore, if you would send us your manuscripts as early as possible so that they are not already published by the time we list them. Thanks!

$RBa_2Cu_3O_{7-\delta}$

Measurements by Y. Ando (CRIEPI) et al. of the in-plane magnetoresistance of heavily underdoped, nonsuperconducting, antiferromagnetic $YBa_2Cu_3O_{6+x}$ (x = 0.30 and 0.32) have revealed novel behavior that unveils a well-developed charged-stripe structure in this system. One of the striking features is magnetoresistance anisotropy with d-wave symmetry upon rotating the magnetic field **H** within the ab plane. Other features are anomalous behavior of the magnetoresistance at low magnetic fields and saturation above a well-defined threshold field, as well as hysteretic behavior at low temperatures. The authors show that the overall features can be consistently explained by assuming a well-developed array of charged stripes and a field-induced topological ordering of the stripes. At temperatures below ~10 K, an external field of the order of a few T can produce a persistent directional ordering of the stripes, giving rise to a memory effect in the resistivity. The authors conclude that charge inhomogeneities in the CuO_2 planes in the form of stripes exist and that they have a considerable impact on the electron transport. The data also show that the magnetic field can be used as a tool to manipulate the striped structure.

The low-energy electronic excitation spectrum and gap structure in optimally doped and overdoped $Y_{1-x}Ca_x$-$Ba_2Cu_3O_{7-\delta}$ single crystals have been investigated by J. Demsar (Ljubljana) et al. using real-time measurements of the quasiparticle relaxation dynamics via femtosecond optical spectroscopy. From the amplitude of the photo-induced reflectivity as a function of time, temperature, and doping x, the authors find evidence for the coexistence of two distinct gaps in the entire overdoped phase. One is a temperature-independent pseudogap Δ_p, and the other is a T-dependent collective gap $\Delta_c(T)$, which has a BCS-like T dependence, closing at T_c. From quasiparticle relaxation-time measurements above T_c, the authors ascertain that fluctuations associated with the collective gap $\Delta_c(T)$ are limited to a few K, consistent with time-dependent Ginzburg-Landau theory, and are unrelated to the pseudogap, whose presence is apparent well above T_c for all x.

The optical conductivity $\sigma(\omega)$ of undoped $YBa_2Cu_3O_6$ has been studied by M. Grüninger (Groningen) et al. in the mid-infrared (MIR) range. The authors made substitutions on all but the *Ba* site to identify the prominent absorption processes at 2800 cm^{-1} and 3800 cm^{-1}, and they collected experimental evidence for bimagnon-plus-phonon absorption. The authors find that existing spin-wave theory is incapable of explaining both MIR and Raman data, and they suggest that only a treatment accounting for short-wavelength magnetic excitations will be able to explain the observed anomalies.

Reversible properties of the remanent magnetic moment M_{rem} in superconducting submicron- and micron-size *YBCO* particles and thin films have been investigated by E. V. Blinov (St. Petersburg) et al. using a SQUID magnetometer. In micron-size particles and thin films, the authors observed a monotonic increase of M_{rem} as the temperature decreased. In submicron particles, the same monotonic behavior was observed at first, but at the lowest temperatures an unusual reentrant behavior was found: M_{rem} decreased when the sample was cooled below 6 K. This phenomenon was found to be independent of the direction of the thermal cycle. The authors discuss possible mechanisms for this effect, including midgap states in the quasiparticle excitation spectrum and defect-induced localization of Cooper pairs.

Bi Cuprates

Heavy Pb doping has been shown to produce large enhancements of both the irreversibility field H_{irr} and the critical current density J_c of $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212).* To investigate the possibility that this effect is due to the reduced electromagnetic anisotropy caused by *Pb* doping, T. Motohashi et al. (Tokyo) have carried out measurements of the out-of-plane resistivity (ρ_c) and in-plane resistivities (ρ_a and ρ_b) of $Bi_{2.1-x}Pb_xSr_{1.8}CaCu_2O_{8+\delta}$ single crystals with various *Pb* content ($0 \le x \le 0.6$). The authors found that the absolute value of ρ_c in the normal state systematically decreased with increasing *Pb* content, whereas no appreciable change was observed in ρ_a and ρ_b. The resistivity anisotropy parameter $\gamma^2 \equiv \rho_c/\rho_{ab} = \rho_c/(\rho_a\rho_b)^{1/2}$ at 100 K was found to be 8.5×10^3, 2.5×10^3, and 1.2×10^3 for oxygen-overdoped crystals with x = 0, 0.3, and 0.6, respectively. These results suggest that the electrical conductivity of the blocking layers is systematically enhanced by *Pb* doping, leading to a large reduction of the resistivity anisotropy in this compound.

A preprint by R. Funahashi (Osaka National Research Institute) et al. reports the properties of heavily *Pb*-doped *Bi-2212/Ag* tapes prepared using an isothermal partial melting method. For the composition $Bi_{1.6}Pb_{0.6}Sr_{1.8}CaCu_2O_{8+\delta}$, the authors found that the irreversibility field H_{irr} for magnetic fields parallel to the c axis is increased at temperatures above 20 K and is comparable with H_{irr} for fields parallel to the ab plane. At 30 K, the authors found that the transport critical current density J_c was nearly independent of the angle of the applied field relative to the c axis.

As noted by K. Kwasnitza (PSI-Villigen) et al., flat high-T_c *Bi-2223/Ag* multifilamentary tapes with a silver matrix have large coupling-current losses in the worst case of perpendicularly applied 50 Hz magnetic fields. The authors report that by surrounding twisted superconducting filaments (twist length 2 cm) by ceramic, nearly insulating $BaZrO_3$ and $SrZrO_3$ barriers, they could reduce the coupling-current-decay time constant to 1.5 ms at 77 K, leading to a significant loss reduction at 25 Hz and a noticeable loss reduction at 50 Hz. For small ΔB values, the coupling-loss maximum was shifted to 110 Hz for a stack of six tapes and to 180 Hz for a single tape. The authors are optimistic that additional loss-reduction techniques (reduction of the aspect ratio to less than 8, reduction of the twist length to less than 1 cm, and further increase of the transverse resistivity) soon will make it possible to fabricate high-T_c conductors with low 50 Hz magnetic field losses at $\Delta B_\perp \ge 0.2$ T.

Other Cuprates

Epitaxial thin films of the *Tl* cuprate superconductors $Tl_2Ba_2CaCu_2O_{8+\delta}$ *(Tl-2212),* $Tl_2Ba_2Ca_2Cu_3O_{10}$ *(Tl-2223),* and $Tl_{0.78}Bi_{0.22}Ba_{0.4}Sr_{1.6}Ca_2Cu_3O_{10}$ *[(Tl,Bi)-1223]* have been studied by R. P. Vasquez (JPL) et al. using x-ray photoemission spectroscopy. In *Cu* 2p spectra, a larger energy separation between the satellite and main peaks (E_S - E_m) and a lower intensity ratio (I_S/I_m) were found to correlate with higher values of T_c. For samples near optimum doping, maximum T_c is reported to occur when the *Tl* $4f_{7/2}$ binding energy is near 117.9 eV, near the middle of the range of values observed for *Tl* cuprates.

Copper NQR experiments in the high-temperature superconductors $YBa_2Cu_4O_8$, $YBa_2Cu_3O_7$, and $La_{2-x}Sr_xCuO_4$ (x = 0.12 and x = 0.15) have been performed by S. Fujiyama (ISSP-Tokyo) et al. using the stimulated echo technique with the rf pulse sequence $\pi/2$ - (τ) - $\pi/2$ - (T - τ) - $\pi/2$. The authors analyze the τ and T dependencies of the stimulated echo intensity using a model that includes the spin-lattice relaxation process (T_1 process) and the fluctuating local field due to nuclear spin-spin coupling. The model gives a quantitative account of the experimental results in $YBa_2Cu_4O_8$ and $YBa_2Cu_3O_7$, using the known values of $1/T_1$ and $1/T_{2G}$, the gaussian decay rate of the spin-echo intensity. The same model applied to $La_{2-x}Sr_xCuO_4$ enabled the authors to extract the value of T_{2G} for this material. The authors found that T_1T/T_{2G} is independent of temperature, indicating that the dynamic exponent z = 1 in $La_{2-x}Sr_xCuO_4$.

Superstructure reflections due to the ordering of holes into stripes in $La_{1.45}Nd_{0.4}Sr_{0.15}CuO_4$ have been studied by T. Niemöller (HASYLAB) et al. using high-energy x-ray diffraction. These reflections have been observed clearly for the first time in a sample that is superconducting at low temperatures (T_c ~ 10 K). The stripe peaks vanish above 62(5) K, whereas the magnetic signal of the stripe ordering, which has been seen with neutrons previously, is already suppressed at ~45 K. The results confirm that the ordering of spins and holes is driven by the charges, as found in the case of $La_{1.6-x}Nd_{0.4}Sr_xCuO_4$ at the doping level of x = 0.12.

Sr_2RuO_4

Though with a T_c less than 1.5 K it is certainly not a high-temperature superconductor, Sr_2RuO_4 has attracted considerable attention because of its many unusual properties. The data suggest that (a) this layered perovskite is an essentially two-dimensional Fermi liquid in the normal state but there are strong correlations among electrons, (b) Sr_2RuO_4 is close to a ferromagnetic instability, which suppresses s- and d-wave superconductivity, and (c) Sr_2RuO_4 in the superconducting state is a triplet p-wave superconductor.

As reported by Y. Sidis (Laboratoire Léon Brillouin, Saclay) et al., inelastic neutron scattering measurements in the normal state of Sr_2RuO_4 reveal the existence of incommensurate magnetic spin fluctuations located at $\mathbf{q}_0 = (\pm 0.6\pi/a,$

$\pm 0.6\pi/a,0$). This finding confirms recent band-structure calculations that have predicted incommensurate magnetic responses related to dynamical nesting properties of the Fermi surface. The authors note, however, that the results cast some doubt on the predominant role of ferromagnetic spin fluctuations in the mechanism of superconductivity for *Sr_2RuO_4*.

The cyclotron masses in single-crystal *Sr_2RuO_4* have been measured by S. Hill (Montana State) et al. through the observation of periodic-orbit resonances, a magnetic-resonance technique closely related to cyclotron resonance. The authors obtain values for the α, β, and γ Fermi surfaces of $(4.33\pm0.05)m_e$, $(5.81\pm0.03)m_e$, and $(9.71\pm0.11)m_e$, respectively. The appreciable differences between these results and those obtained from de Haas-van Alphen measurements are attributable to strong electron-electron interactions in this system. The authors note that their findings are consistent with predictions for a strongly interacting Fermi liquid; semiquantitative agreement is obtained for the electron pockets β and γ.

Using a Ginzburg-Landau functional of E_u symmetry due to D. F. Agterberg [Phys. Rev. Lett. **80**, 5184 (1998)] and the Landau-level expansion method, T. Kita (Hokkaido) has studied vortex states over the range $H_{c1} \le H \le H_{c2}$ to provide a test of the possibility that p-wave pairing occurs in *Sr_2RuO_4*. For the field **H** in the basal plane, the author finds that (a) a second superconducting transition should be present irrespective of the field direction, (b) below this transition, a characteristic double-peak structure may develop in the magnetic-field distribution, and (c) a third transition may occur between two different vortex states. The author also finds that when the field is along the c axis, the square vortex lattice may deform through a second-order transition into a rectangular one as the field is lowered from H_{c2}.

Vortices

The dependence of the quasiparticle density of states of a two-dimensional d-wave superconductor upon the orientation of an in-plane external magnetic field **H** has been calculated by E. Schachinger and J. P. Carbotte (McMaster). The dependence arises because in the region of the gap nodes, the Doppler shift due to the circulating supercurrents around a vortex core depends upon the direction of **H**. For a tetragonal system, the induced pattern is four-fold symmetric, and the density of states at zero energy exhibits minima when **H** points along the node directions. In orthorhombic systems, such as *$YBa_2Cu_3O_{6.95}$,* the pattern becomes two-fold symmetric, with the position of the minima occurring when **H** is oriented along the Fermi velocity at a node on the Fermi surface.

Two different vortex states in a long Josephson junction generated by a nearby Abrikosov vortex are considered in a paper by D. Agassi and J. R. Cullen (NSWC). A conventional state, in which there are no vortices in the junction, has total magnetic flux $\phi_0 = hc/2e$. A second state, which has higher energy, has two antivortices in the junction, such that the total magnetic flux is $-\phi_0$. The energies of the two states tend to the same value as the Abrikosov vortex approaches the Josephson-junction plane.

Using electrical transport measurements, C. Goupil et al. (Caen) have studied the ohmic plastic dissipation of twinned *YBCO* samples with a magnetic field aligned along the c axis. The authors extracted the activation energy U(T,B) and analyzed it in terms of magnetically induced pinning by twin planes. The presence of twin planes leads to a crossover from a field-independent activation energy at low fields to a $B^{-0.5}\ln B$ dependence at high fields. The authors compare this two-step response with similar observations in heavy-ion-irradiated samples.

Using high-resolution SQUID magnetometry, M. Baumann (Hamburg) et al. have studied the influence of columnar defects of field-equivalent density $B_\phi = 1$ T on the flux creep in thin *$YBa_2Cu_3O_{7-\delta}$* films. At temperatures $T^*(B,B_\phi)$, the relaxation rates reveal a sharp crossover from a glassy dynamics to a faster algebraic flux creep, which disappears at the transition lines $T_c(B)$ to equilibrium superconductivity.

The height of the nucleation barrier for vortex penetration into a thin superconducting disk has been calculated by V. A. Schweigert and F. M. Peeters (Antwerpen). The authors made use of an expansion of the order parameter over the eigenfunctions of the linearized first Ginzburg-Landau equation.

A preprint by D. E. Feldman (Texas A&M and Landau Institute) et al. considers the behavior of vortices in a superconducting film on which an array of randomly oriented magnetic dots is placed. The authors find that the concentration of vortices bound to the dots is proportional to the dot density and depends on the dot's magnetization in a step-like way. The concentration of unbound vortices is found to oscillate about a value that is proportional to the magnetic moment of the dots.

Films

The Hall conductivities of *$HgBa_2CaCu_2O_{6+\delta}$ (Hg-1212)* and *$HgBa_2Ca_2Cu_3O_{8+\delta}$ (Hg-1223)* thin films in magnetic fields parallel to the c axis have been investigated by W.-S. Kim (POSTECH) et al. The authors report that the mixed-state Hall conductivity is well described by $\sigma_{xy} = C_1/H + C_2 + C_3H$. The prefactor C_1 exhibits

a temperature dependence of the form $C_1 \propto (1 - T/T_c)^n$ near T_c, where the exponent $n \approx 2.3$ for *Hg-1212* and 1.8 for *Hg-1223,* comparable with values previously found for $YBa_2Cu_3O_{7-\delta}$ and $La_{2-x}Sr_xCuO_4$. Contrary to previous results, C_2 follows a temperature-scaling behavior similar to that of C_1, but with exponent $n' \approx 3.2$ for *Hg-1212* and 2.0 for *Hg-1223*.

In research exploring the possibility of applying metal organic decomposition (MOD) techniques to deposit buffer layers and *YBCO* films on flexible metallic textured substrates, S. Sathyamurthy and K. Salama (TCSUH) have used the trifluoroacetate (TFA) process to deposit buffer-layer films and *YBCO* films on single-crystal substrates. *YBCO* films of thickness 0.3-0.5 μm deposited on barium-zirconate-buffered strontium titanate were found to have transition temperatures of 86-88 K and critical current densities of the order of 10^4 A/cm^2 at 77 K in self-field. *YBCO* films deposited on strontium-titanate-buffered lanthanum aluminate had transition temperatures of 90-91 K and J_cs of the order of 10^5 A/cm^2.

Applications

A preprint by Y. H. Kim (KIST) et al. reports on the design, fabrication, and operation of a single-flux-quantum (SFQ) reset-set (RS) flip-flop based on *YBCO* grain-boundary junctions on a $SrTiO_3$ bicrystal substrate. The circuit consisted of a read SQUID and an RS flip-flop, which were magnetically coupled. The circuit operated correctly in the temperature range 65-71 K. At 71 K, the circuit operated over 100 RS operations without error. The authors also measured the effect of noise on switching a Josephson junction to the voltage state in an SFQ circuit.

The nonlinear surface impedance of a thin superconducting strip carrying a microwave current has been calculated numerically by T. Dasgupta et al. (Northeastern). The calculations, based upon flux penetration due to a current-induced critical state, approach known analytic results in the thin-film limit. The authors suggest that their numerical technique will be useful in the design of passive superconducting microwave circuits.

Using two lock-in amplifiers and an appropriate correction scheme, S. Krüger-Olsen (TU Denmark) et al. have measured the ac losses of a low-loss 10 m long *Bi-2223/Ag* superconducting cable. The 1 μV/cm critical current of the conductor was 3240 A at 77 K, and at an rms current of 2 kA, the 50 Hz ac loss was found to be (0.6±0.15) W/m. The authors believe this to be the lowest ac power loss of a high-temperature superconducting cable reported so far at such high currents.

Theory

A theory of angle-resolved photoemission (ARPES) in doped cuprates and other charge-transfer Mott insulators has been developed by A. S. Alexandrov and C. J. Dent (Loughborough), taking into account a realistic (LDA+U) band structure, (bi)polaron formation due to the strong electron-phonon interaction, and a random field potential. In most of these materials, the first band to be doped is the oxygen band inside the Mott-Hubbard gap. The authors derive the coherent part of the ARPES spectra with the oxygen hole spectral function calculated in the noncrossing (ladder) approximation and with the exact spectral function of a one-dimensional hole in a random potential. Some unusual features of ARPES, including the polarization dependence and spectral shape in $YBa_2Cu_3O_7$ and $YBa_2Cu_4O_8$, are described without any Fermi surface, large or small. The authors assert that the theory is compatible with the doping dependence of kinetic and thermodynamic properties of the cuprates, as well as with the d-wave symmetry of the superconducting order parameter.

The ground state of the two-dimensional Hubbard model has been studied by Y. Asai (ETL) using a quantum Monte Carlo method and paying special attention to the shell-structure effect on finite-size clusters (6×6 and 10×10 lattices). The calculations show that there is a gap for spin excitations in the ground state and incommensurate peaks at $(\pi \pm \delta, \pi)$ and $(\pi, \pi \pm \delta)$ in the spin correlation function for a low-lying excited state. In the ground state, the long-range part of the d-wave superconducting correlation function is enhanced, and the momentum distribution function at the Fermi level $(\pi, 0)$ is rounded. The gap in spin excitations and the momentum distribution function rounding is consistent with the opening of a d-wave superconducting gap in the ground state.

According to a preprint by V. M. Loktev (Kiev) et al., the presence of nonmagnetic impurities in a 2D “bad metal” depresses the superconducting Berezinskii-Kosterlitz-Thouless transition temperature, while leaving the pairing scale unchanged. Thus, in the presence of nonmagnetic impurities, the pseudogap phase, where the modulus of the order parameter is nonzero but its phase is random, is bigger than it is for the clean system. In addition, the theoretical temperature dependence of the superfluid density in the presence of impurities is closer to experiment than that in the clean limit.

Using a large-N expansion, A. Greco (Rosario) and R. Zeyher (MPI-Stuttgart) solve the linearized equation for the superconducting gap for a generalized t-J model that also contains phonons within a Holstein model. Keeping all terms up to O(1/N), the authors find that the kernel of the gap equation consists of an electron-phonon part with self-energies and vertex functions renormalized by the interactions of the t-J

model, and a t-J part unaffected by phonons. Including both the electron-phonon part and the t-J part in the gap equation, the authors find that the leading T_c always has d-wave symmetry, with phonons giving a positive contribution to T_c.

The effect of the Zeeman magnetic field in the superconducting phase in a two-component order-parameter scenario, such as $d_{x^2-y^2} + e^{i\theta}\alpha$, where $\alpha = d_{xy}$ or s, has been studied by H. Ghosh (Arizona). The author notes that this scenario is equivalent to applying a magnetic field parallel to the CuO_2 planes.

Current fluctuations in a normal-metal/d-wave superconductor junction with a [110]-oriented interface have been investigated by J. X. Zhu and C. S. Ting (TCSUH). The authors find that the sign change of the d-wave order parameter has an important effect on the voltage dependence of the shot-noise power. The predicted current-fluctuation behavior is qualitatively different from that in a normal-metal/s-wave superconductor junction.

A three-dimensional lattice of Josephson junctions with a finite self-inductance has been used by M. S. Li (Warsaw) to model ceramic superconductors. The author studied the nonlinear ac susceptibility, second-harmonic generation in the presence of a dc magnetic field, and the compensation effect discussed by Ch. Heinzel et al. [Phys. Rev. B **48**, 3445 (1993)] in studies of the paramagnetic Meissner effect (PME). Using Monte Carlo simulations modeling an array of 0- and π-junctions, the author finds, in agreement with experiment, that the compensation effect may be present in ceramic superconductors that show the PME.

A numerical technique for recovering the missing phase information for a set of critical current measurements as a function of the applied magnetic field $I_c(B)$ is described by M. Carmody (Argonne and Northwestern) et al. The authors assert that in many cases the profile of the maximum Josephson critical current density $J_0(x)$ along the length of the boundary can be determined.

As noted in a preprint by V. A. Schweigert and F. M. Peeters (Antwerpen), the nucleation field for surface superconductivity, H_{c3}, depends on the geometrical shape of the sample and is substantially enhanced with decreasing sample size. The authors studied circular, square, triangular, and wedge-shaped disks of uniform thickness in a perpendicular magnetic field. For a wedge with interior angle α, the authors found that the nucleation field diverges as $H_{c3}/H_{c2} = 3^{1/2}/\alpha$ in the limiting case of $\alpha << 1$. For $\alpha = \pi/2$, the authors found $H_{c3}/H_{c2} = 1.96$, and for $\alpha = \pi$, they recovered the well-known result $H_{c3}/H_{c2} = 1.695$.

Other Activities

To test for the possibility of a gravity shielding effect in the superconducting state, H. Reiss (ABB, Heidelberg) measured the weight of a pile of *Bi-2212* pellets inside a sample holder submerged in liquid nitrogen as the sample cooled to 77 K. The apparent weight increased with time (as the sample cooled) when the sample holder contained superconductors, normal conductors, or nonconductors. This was a consequence of the continuously reduced convective liquid motion and bubble lift-off. The author reports that the superconductor samples, however, gained slightly more weight than the normal or nonconductors, giving rise to a relative increase of the superconductor sample weights by about 0.5%, which the author tentatively interprets as a gravity shielding effect. Application of an external magnetic field, produced by permanent magnets placed on the top and bottom of the stack of superconducting pellets inside the sample holder, eliminated the observed effect. The author welcomes comments from colleagues who would be able to confirm or reject the observations.

A preprint by P. Kumar (Florida) et al. suggests that the transition to superconductivity in a single crystal of $Ba_{0.6}K_{0.4}BiO_3$ (T_c = 32 K), having critical fields with anomalous temperature dependencies and vanishing discontinuities in the specific heat and magnetic susceptibility, may be an example of a fourth-order (in Ehrenfest's sense) phase transition. The authors have derived a free-energy functional for a fourth-order transition and calculated (for the temperature range $T_c/2 < T \leq T_c$) the temperature dependence of the critical fields. The authors find that $H_{c1}(T) \propto (1 - T/T_c)^3$, $H_c(T) \propto (1 - T/T_c)^2$, and $H_{c2}(T) \propto (1 - T/T_c)^1$, in general agreement with experiments.

A systematic study of the time evolution of the transport critical current in polycrystalline samples of the high-temperature superconductors $(Hg_{1-x}Re_x)Ba_2Ca_2Cu_3O_{8+\delta}$ *[(Hg,Re)-1223]* and $YBa_2Cu_3O_{7-\delta}$ *(Y-123)* after application and removal of an external magnetic field has been carried out by E. Altshuler (Havana) et al. The transport critical current was found to increase logarithmically with time. The authors explain this finding in terms of a model in which the transport critical current is determined by the effective field in the intergrain junctions, which relaxes logarithmically with time because of intragranular flux creep.

The peak effect in the critical current in $CuBa_2SmCu_2O_{7-\delta}$ *(Cu-1212:P* or *Sm-123),* $CuBa_2Ca_3Cu_4O_{10+\delta}$ *(Cu-1234),* $(Hg,Pb)(Ba,Sr)_2Ca_2Cu_3O_{8+\delta}$ *[(Hg,Pb)-1223],* and *YBCO* melt-grown composites has been studied by H. Yamauchi et al. (Tokyo Tech). The authors conclude that the peak effect in various layered copper-oxide superconductors is most likely caused by rather periodic modulations of the local superconducting properties with a period of tens of nanometers.

Experimental data obtained by different techniques are examined by A. Mourachkine (Brussels). The author finds that the data are not easy to explain by any theoretical model presented in the literature, but can be explained by an MCS model (magnetic coupling of stripes).

Overviews

An overview by J. B. Marston (Brown) argues that recent years have seen a consilience, a coming together, of theories of high-temperature superconductivity. The author stresses that some of the more promising descriptions - gauge theories, coupled chains, nesting instabilities, nodal liquids, and stripes - share features in common (57 refs.).

Contributed by John R. Clem

Contents:

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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.

Recently, American Superconductor Corporation announced its first order to install a Distributed Superconducting Magnetic Energy Storage (D-SMES) system to improve reliability and capacity in an electric-utility network. The D-SMES system will consist of six individual SMES units that will be deployed within the next year at five electrical substations in a large-scale transmission network in the Wisconsin Public Service Corporation service territory. This order launches a new product line for the SMES technology and company officials anticipate the D-SMES system will play a key role in improving power transmission reliability while increasing the effective operating capacity of existing power transmission networks. Wisconsin Public Service (WPS) will deploy the D-SMES system in its Northern Transmission Loop, a network approximately 200 miles in circumference that is located in the Wausau and Eagle River areas of Wisconsin. Network analyses, performed by American Superconductor with WPS, identified precise locations for the SMES units within the network for optimum voltage stabilization in the event of transients in the system caused by such factors as severe weather, traffic accidents, or unanticipated equipment failures. Installation of the units is planned to begin in January and be completed and online by March 2000. For this first D-SMES system, American Superconductor included an innovative buyback provision that gives Wisconsin Public Service a high degree of flexibility in strengthening its position in the new, competitive utility environment. For further information, contact American Superconductor Corporation, Two Technology Drive, Westborough, MA 01581; telephone (508) 836-4200; telefax (508) 836-4248. Media contact is Kevin Coates, telephone (202) 434-8308, e-mail kcoates@washington.com.

At the AEA Financial Growth Summit in Monterey, Calif., Conductus, Inc. announced an agreement with General Dynamics to jointly develop HTS technology and pursue government market opportunities. Under this agreement General Dynamics Information Systems (GDIS) will purchase rights to Conductus' HTS thin-film technology and other intellectual property for $5M plus future royalties, and will have exclusive rights to use and sell this technology in the government marketplace. Conductus will continue to develop, design, and manufacture products for GDIS as part of a separate Cross-License, Supply and Training agreement. For information, contact Conductus, Inc. 969 W. Maude Avenue, Sunnyvale, CA 94086; telephone (408) 523-9950; telefax (408) 523-9999.

Contributed by Sreeparna Mitra

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D. Agassi and J. R. Cullen, "New Vortex State in the Presence of a Long Josephson Junction." To be published in Physica C (in press). Code 68, Carderock Division, Naval Surface Warfare Center, 9500 MacArthur Blvd., West Bethesda, MD 20817; fax (301) 227-4733; e-mail agassi@oasys.dt.navy.mil. Key words: Josephson junction, vortex state, Abrikosov vortex.

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*(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.)*

Aug. 29 - Sept. 3 1999: International

Conference on the Applications of the Mössbauer Effect, Garmisch-Partenkirchen, Germany. Will focus on the communication of results of Mössbauer spectroscopy in all fields. Invited talks, oral contributions, and posters. For information, contact Klaus Achterhold, ICAME-99, Physikdepartment E17, TUM, D-85747 Garching, Germany; telephone +49 89 289 12559; telefax +49 89 289 12548; e-mail ICAME@physik.tu-muenchen.de; Web site http://www.physik.tu-muenchen.de/~icame.

Nov. 29 - Dec. 3, 1999: Materials

Research Society Fall 1999 Meeting: Symposium Q – Advances in Materials Problem Solving with the Electron Microscope, Boston, Mass. Contributions that make use of recent developments in elecron microscopy (rather than just "routine" imaging) to solve materials problems are solicited, in areas such as: structural metallic alloys (e.g., alloy development, phase transformations); structural and electronic ceramics, composites, and minerals; polymers, zeolites, catalysts, and fullerenes; microelectronic materials and electroluminescent materials; epitaxial and polycrystalline thin films and multilayers; and magnetic materials for permanent magnets and data storage. **Abstract deadlines, June 7, 1999 (paper, fax, and e-mail submissions); June 21, 1999 (Web submissions).** Contact Charles Allen, Argonne National Laboratory, Electron Microscopy Ctr.-HVEM-Tandem Facility, MSD 212/E211, 9700 South Cass Ave., Argonne, IL 60439; telephone (630) 252-4157; telefax (630) 252-4798 or -4298; e-mail allen@aaem.amc.anl.gov; conference Web site http://www.mrs.org/meetings/fall99/.

May 28 - June 2, 2000: International

Conference on Transport Processes in Inorganic Materials: Fundamentals to Devices, Venice (Jesolo Beach), Italy. Objective is to discuss recent developments in microscopic mechanisms of transport in different inorganic materials; assess the role of transport in materials reactivity, synthesis, and processing; explore the transport mechanisms which affect materials properties and behavior under operating conditions; and exploit the role of transport processes in a number of advanced technologies of current or emerging interest. Papers are solicited in a several areas, including diffusion and transport in media of lower dimensionality, single-crystal growth, materials processing for HTS materials, and superconducting devices for high- and low-field applications. For information, contact CIMTEC-Transport Phenomena Conference, P.O. Box 174, I-48018 Faenza, Italy; telefax +39 0546 664138.

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