HIGH $T_C$ UPDATE

VOL. 13, NO. 21
NOV. 1, 1999

ARPA

# NOTA BENE:

**A big thank-you to those of you who have pledged $200 for an annual subscription to *High-$T_C$ Update.* To the organizations who have pledged $1000 or more, we are moved by your generosity! We do, however, have a very long way to go to reach our target number of subscribers. Please keep the pledges coming!**

**Correction:** We apologize to F. M. Araujo-Moreira for giving his name incorrectly twice in the October 1 issue (as A. M. Araujo-Moreira and F. M. Araugo-Moreira).

## MOCVD YBCO on IBAD YSZ

*As reported* by V. Selvamanickam (IGC) et al., a metal-organic-chemical-vapor-deposition (MOCVD) method has been developed to achieve high currents in *$YBa_2Cu_3O_{7-\delta}$ (YBCO)* superconducting films deposited on biaxially textured buffer layers over untextured metal substrates. Biaxially textured buffer layers of yttria-stabilized zirconia *(YSZ),* typically 0.5-1 μm thick, were deposited on polished Hastelloy-C and Inconel 625 metal substrates (thickness ≈ 100 μm) by ion-beam-assisted deposition (IBAD). To deposit the *YBCO* films on the *YSZ,* tetramethyl heptanedionate *(THD)* precursors for *Y, Ba,* and *Cu* were vaporized, the vapors were mixed with a carrier gas of *Ar* and *$O_2$,* and the precursor mixture was then injected into the *MOCVD* reactor, where *YBCO* films of thickness 1 μm were deposited within a temperature regime of 700-800°C at a reactor pressure of 1-5 torr.

The IBAD *YSZ* buffer layers exhibited strong biaxial texture; the in-plane texture was 15-25° full width at half maximum (FWHM). The *YBCO* films deposited on the *YSZ*-buffered metal substrates had the structure of a dense, continuous film with hardly any porosity but with numerous particulates, which were rich in *Y.* Despite the particulate formation, the *YBCO* films exhibited strong c-axis texture and good in-plane texture: ≈4° FWHM.

*Current-voltage* (I-V) measurements were carried out with continuous dc currents up to 80 A on samples of thickness 1 μm and length 10 mm across the entire width of the film (3.5 mm) without any patterning. The authors report critical currents $I_C$ and critical current densities $J_C$ at 75 K (the boiling point of liquid *$N_2$* in Los Alamos) and at 64 K (obtained by pumping on the liquid *$N_2$*). In self-field at 75 K, an $I_C = 45$ A was achieved, which corresponds to $J_C = 1.3 \times 10^6$ A/cm$^2$. The dependence of $J_C$ on magnetic field was examined with the field oriented parallel and perpendicular to the c axis. The dependence of $J_C$ upon the angle θ between the magnetic field and the c axis also was measured for fields of 1, 2, 3, 4, 5, and 6 T. The magnetic-field dependence of $J_C$ indicates a strong-linked behavior at low fields and strong pinning at high magnetic fields. The value of $J_C$ increased by about a factor of three when the temperature was lowered from 75 to 64 K. The dependence of $J_C$ on θ showed a peak due to intrinsic pinning when **B** was parallel to the layers (**B** ⊥ c, θ = 90°) and no peak when **B** was perpendicular to the layers (**B** || c, θ = 0°).

*Some representative* reported values of $J_C(B,\theta,T)$ are $J_C(1\text{ T}, 90°, 75\text{ K}) = 5.7 \times 10^5$ A/cm$^2$, $J_C(5\text{ T}, 90°, 75\text{ K}) = 2.4 \times 10^5$ A/cm$^2$, $J_C(1\text{ T}, 0°, 75\text{ K}) = 2.2 \times 10^5$ A/cm$^2$, $J_C(2.5\text{ T}, 0°, 75\text{ K}) = 1.0 \times 10^5$ A/cm$^2$, $J_C(2\text{ T}, 90°, 64\text{ K}) = 1.2 \times 10^6$ A/cm$^2$, $J_C(5\text{ T}, 90°, 64\text{ K}) = 7.7 \times 10^5$ A/cm$^2$, $J_C(1\text{ T}, 0°, 64\text{ K}) = 6.8 \times 10^5$ A/cm$^2$, $J_C(2\text{ T}, 0°, 64\text{ K}) = 5.2 \times 10^5$ A/cm$^2$, $J_C(5\text{ T}, 0°, 64\text{ K}) = 3.0 \times 10^5$ A/cm$^2$. The authors note that the high-current films still show numerous particulates, the reduction of which could lead to even higher current densities in *YBCO* films deposited by MOCVD. The authors also stress that this demonstration of high $J_C$, as well as high currents ($I_C$), in useful magnetic fields at 64 K and 75 K supports the viability of the MOCVD process as a candidate for the fabrication of *YBCO* coated conductors for electric power applications.

## Films

*A preprint* by M. Lorenz (Leipzig) et al. reports that a large-area pulsed-laser-deposition (PLD) process for high-quality *YBCO* thin films on both sides of R-plane sapphire

substrates with $CeO_2$ buffer layers is being used routinely to optimize planar microwave filters for satellite and mobile communication systems. With the experience of more than 700 double-sided three-inch-diameter *YBCO:Ag* films, the authors have achieved a high degree of reproducibility of $J_c$ values above $3.5 \times 10^6$ A/cm$^2$ and state-of-the-art $R_S$ values. A high degree of reproducibility and uniformity is revealed in maps (2D scans) of the critical current density $J_c$ and microwave surface resistance $R_S$ across the wafers. The authors also discuss the potential of $YBCO/SrTiO_3/YBCO/CeO_2$ film systems on R-plane sapphire wafers for use in tunable microwave resonators.

*The electrical* properties of 10°-tilted *YBCO* films grown epitaxially upon as-received (106) $SrTiO_3$ substrates are described in a preprint by P. S. Czerwinka (Nottingham) et al. The authors report that the normal and superconducting properties exhibit significant differences depending upon whether the *YBCO* films are grown upon unannealed or annealed substrates.

High-$T_c$ bilayers and trilayers based on $NdBa_2Cu_3O_{7-\delta}$ *(NBCO)* using $Sr_2AlTaO_6$ *(SAT),* $Sr_2AlNbO_6$ *(SAN),* and lanthanum-doped *SAT* $[La_xSr_{2-x}AlTaO_6$ *(LSAT)]* as insulators have been grown *in-situ* on $SrTiO_3$ substrates by Y. Li et al. (SRL-ISTEC) using PLD. The high stability and compatibility with sharp interfaces of these multilayers were demonstrated by TEM observations. Although the as-grown bilayers showed a low $T_c$ value of ~50 K, the top and bottom *NBCO* layers showed a $T_c$ of 87-90 K and $J_c > 1 \times 10^6$ A/cm$^2$ at 77 K after annealing in $O_2$ at 450°C.

*The characteristics* of *NBCO* Josephson junctions fabricated by the high-resolution focused-ion-beam (FIB) etching technique have been investigated by K. Ohnishi et al. (SRL-ISTEC). After optimization of the FIB etching technique, the junctions exhibited RSJ-like characteristics. The spreads in $I_c$ and $R_n$ for 29 working junctions on the same substrate at 4.2 K were 40% and 60%, respectively. The $I_c$ spread was caused primarily by the instability of the FIB and the substrate temperature during thin-film deposition.

# Applications

*The development* of *YBCO,* low-noise, direct-coupled high-$T_c$ superconducting-quantum-interference-device (SQUID) magnetometers based on 30° bicrystal junctions is reported by F. Ludwig and D. Drung (PTB-Berlin). These magnetometers consist of a 100 pH SQUID loop with a linewidth of 4 μm and a pickup coil consisting of 16 parallel 50-μm-wide loops. The magnetic-field noise down to 1 Hz did not increase when the magnetometers were exposed to ac fields with peak-to-peak amplitudes of up to 54 μT or cooled in static magnetic fields above that of the earth. The lowest noise at 1 Hz of such a device cooled in 64 μT was 65 fT Hz$^{-1/2}$. The increased noise below 1 Hz when the devices were cooled in a static magnetic field can be quantitatively described by the measured temperature fluctuations assuming a temperature coefficient of the pickup loop area of about $1 \times 10^{-4}$/K.

# $RBa_2Cu_3O_{7-\delta}$

*Measurements* of the nonresonant microwave absorption in a $YBa_2Cu_3O_{7-\delta}$ *(YBCO* or *Y-123)* bulk sample have been carried out by J. Yamada et al. (Mie) as a function of the dc field sweep rate at 77 K. The authors found that the absorption increases with increasing sweep rate and that it saturates at the highest sweep rates. The authors interpret this behavior in terms of different flux profiles near the surface at different sweep rates.

Levitation and stability forces have been studied by W. Hennig et al. (TCSUH) using *YBCO* trapped-field magnets (TFMs) to replace permanent magnets (PM). TFMs with maximum trapped field $B_{TFM}$ up to 1.6 T at 77 K were used and compared with a PM with $B_{PM}$ = 0.34 T at its surface. The authors found that the levitation force with the TFM can be more than a factor of 10 larger than that with the PM. The authors also found that both levitation and stability forces can be significantly increased using multi-sample systems.

*As reported* by W. Lo et al. (IRC-Cambridge), large, single-grain $NdBa_2Cu_3O_{7-\delta}$ *(NBCO* or *Nd-123)* composites containing $Nd_4Ba_2Cu_2O_{10}$ *(Nd-422)* phase inclusions have been fabricated up to 2 cm in diameter using a top-seeded melt-textured-growth technique. An *MgO* single-crystal seed was used to provide a heterogeneous nucleation site at the center of a pre-sintered pellet, which was heated above its peritectic temperature and then cooled continuously in a conventional tube furnace in reduced oxygen partial pressure. For magnetic fields applied both perpendicular and parallel to the crystallographic c axis, the *NBCO* grains exhibited a very high irreversibility field (> 9 T at 77 K), which is significantly higher than that observed in good-quality melt-processed *YBCO*.

Transport and magnetic-relaxation properties of the mixed state in strongly underdoped $Y_{1-x}Pr_xBa_2Cu_3O_{7-\delta}$ single crystals have been studied by T. Stein (Kent State) et al. using a flux-transformer contact configuration. The authors observed two correlated phenomena: a coupling transition and a transition to quantum creep. The distribution of transport current below the coupling transition was found to be highly nonuniform, which facilitates quantum creep. The authors speculate that in the mixed state below the coupling transition, where dissipation is nonohmic, the current distribution may be unstable with respect to self-channeling, resulting in the formation of very thin current-carrying layers.

*Strong signatures* of *Mg* substitution in $YBa_2(Cu_{1-x}Mg_x)_3O_{7-\delta}$ have been obtained by J. Figueras et al. (Bellaterra) from single-domain samples prepared by top-seeding using $YBa_2Cu_3O_{7-\delta}$ + 30 wt% $Y_2BaCuO_5$ + X wt% *MgO* mixtures. The authors found a drastic decrease of the superconducting transition temperature with increasing X, reaching $T_c \sim 40$ K for X = 16.7. The $T_c(x)$ dependence and thermogravimetric results suggest that *Mg* atoms substitute for *Cu* on *Cu(2)* sites and that a solubility limit exists.

# Bi Cuprates

*The temperature* dependence of electronic Raman scattering has been explored by O. V. Misochko (Chernogolovka and KARC) in $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* crystals. In optimally doped crystals, the temperature dependence of the static Raman ($\omega \rightarrow 0$) slope suggests that the gap nodes are shifted from the positions they would have for pure d-wave pairing. The author also notes that the low-frequency part of the $B_{1g}$ spectra as a function of progressively stronger disorder gives further evidence for a mixed order parameter.

A preprint by V. M. Krasnov (Chernogolovka) et al. reports a study and comparison of the perpendicular (c-axis) transport properties of the layered high-$T_c$ superconductor (HTS) *Bi-2212* and low-$T_c$ (LTS) *Nb/Cu* multilayers. For both HTS and LTS samples, similar anomalous features were observed: (a) The c-axis critical current $I_c$ is multiple-valued as a function of temperature T and in-plane magnetic field H. (b) $I_c$ exhibits extremely large fluctuations, and the probability distribution $P(I_c)$ has multiple maxima. (c) The $I_c(H)$ patterns are aperiodic. (d) In the dynamic state, the flux-flow branches in current-voltage characteristics consist of multiple closely spaced sub-branches and exhibit large fluctuations due to switching between sub-branches. The experimental data are in qualitative agreement with numerical simulations for a stack of long, strongly coupled Josephson junctions. All this is taken as evidence for the existence of multiple quasiequilibrium Josephson fluxon modes in these samples.

*The subsolidus* equilibria and the primary phase field (crystallization field) of the 110 K high-$T_c$ $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ *[(Bi,Pb)-2223]* phase in the presence of *Ag* under an atmosphere of 7.5 vol% $O_2$ + 92.5 vol% *Ar* have been determined by W. Wong-Ng (NIST-Gaithersburg) et al. The authors studied a total of 29 six-phase volumes that include both the *(Bi,Pb)-2223* and *Ag* phases. These subsolidus volumes were similar to those observed without the presence of *Ag*. The compositional ranges of initial melts of these volumes on a mole fraction basis were 5.6-25.3% $BiO_{1.5}$, 0.4-13.8% *PbO,* 8.4-31.9% *SrO,* 12.2-33.3% *CaO,* 21.7-40.9% *CuO,* and 1.2-6.3% $AgO_{0.5}$. From the data, the authors constructed the primary crystallization field for the *(Bi,Pb)-2223* phase in the presence of *Ag* using the convex hull technique. A section through this "volume" portrayed by holding the $AgO_{0.5}$, *SrO,* and *CaO* components at the median value of the 29 compositions while allowing projection on the other three axes $(BiO_{1.5}$, *PbO,* and *CuO).* The net effect of *Ag* on the melt composition is a reduction in the *PbO* concentration and an increase in the *SrO* content.

*The melting* equilibria of $Bi_{1.8}Pb_{0.4}Sr_2Ca_{2.2}Cu_3O_{10+\delta}$ under oxygen have been determined by W. Wong-Ng and L. P. Cook (NIST-Gaithersburg).

The effects of bend strains on monocore *Bi-2223* tapes have been studied by N. Vasanthamohan et al. (Argonne) using transport measurements, magneto-optical imaging, and electron microscopy. The authors find that the observed strain tolerance is largely determined by the interplay of nonuniform strains and microstructural variation across the tape cross section, leading to nonuniform $I_c$ values. The authors find that a model accounting for the observed concentration of the critical current density at the *Ag/Bi-2223* interface can provide an explanation for the measured strain dependence on the retained $I_c$.

*The effect* of bending cycles on *Ag/Bi-2223* composites in the form of tapes with 1, 7, and 19 ceramic filaments has been studied by M. T. Malachevsky and D. A. Esparza (Bariloche). The authors found that multifilamentary tapes better withstand cycling.

# Other Cuprates

*As discussed* by Z. A. Xu (Princeton) et al., the *Nd*-doped cuprate $La_{2-y-x}Nd_ySr_xCuO_4$ displays a first-order phase transition at $T_d$ (= 74 K for x = 0.10, y = 0.60) to a low-temperature tetragonal (LTT) phase. A magnetic field **H** applied parallel to the a axis leads to an increase in $T_d$, but when **H** is parallel to c, $T_d$ is decreased. These effects show that magnetic ordering involving both *Nd* and *Cu* spins plays a key role in driving the LTO-LTT transition. The authors also observed related anisotropic effects in the uniform susceptibility and the in-plane magnetoresistance.

A preprint by E. Kandyel et al. (SRL-ISTEC) reports the synthesis of $(La_{1-x}Sr_x)_8Cu_8O_{20-\delta}$ (*8-8-20* phase) compounds with x in the range $0.25 \leq x \leq 0.65$ using an $O_2$ HIP apparatus. The electrical resistivity and magnetic susceptibility showed metallic behavior from room temperature down to 5 K with no sign of superconductivity.

*A double-TlO*-layer superconductor with three $CuO_2$ sheets in the *Tl-Sr-Ca-Cu-O* system, $(Tl_{1-x}Hg_x)_2Sr_2Ca_2Cu_3O_y$ [*(Tl,Hg)-2223,* x = 0.35], has been synthesized by E. Kandyel et al. (SRL-ISTEC) using a high-pressure, high-temperature technique. As-prepared samples exhibited superconductivity below 103 K. The authors also synthe-

sized *($Tl_{1-x}Hg_x)_2Sr_2CaCu_2O_y$ [(Tl,Hg)-2212,* x = 0.35] under 3 GPa. It showed a superconducting transition at 60 K, which is 35 K higher than that reported for samples synthesized under ambient pressure.

*The electronic* Raman spectra of strongly underdoped *$HgBa_2Ca_2Cu_3O_{8+\delta}$ (Hg-1223)* have been studied by A. Sacuto (Ecole Normale Supérieure) et al. The authors were able to report with good accuracy the pure electronic Raman scattering (without subtraction of phonons) in the $B_{2g}$, $B_{1g}$, $A_{1g} + B_{2g}$, and $A_{1g} + B_{1g}$ channels. The $d_{x^2-y^2}$ model fits the low-energy part (below 350 $cm^{-1}$) of the spectra for $B_{2g}$ and $A_{1g}$ symmetries and up to the gap energy for $B_{1g}$. However, to reconcile the upper part of the $B_{1g}$ and $B_{2g}$ spectra (above 350 $cm^{-1}$) with the $d_{x^2-y^2}$ model, the authors needed to expand the $B_{2g}$ vertex to the next order of Fermi-surface harmonics. The sharp and intense maximum in mixed $A_{1g}$ symmetries is not easy to interpret in the framework of the $d_{x^2-y^2}$ model.

After analyzing tunneling, inelastic neutron scattering, and torque measurements in a variety of hole-doped high-$T_c$ cuprates, A. Mourachkine (Brussels) concludes that the Cooper pairs in the cuprates consist of spinons and that the pairing order parameter has anisotropic s-wave symmetry, whereas the order parameter for long-range phase coherence has a magnetic origin due to spin fluctuations and has $d_{x^2-y^2}$ symmetry.

# Vortices

*The main* features of Hall tunneling of pancake vortices in superclean high-$T_c$ superconductors have been considered theoretically by D. A. Gorokhov and G. Blatter (ETH-Zürich). The authors describe the general formalism for the calculation of the lifetime of a vortex pinned in a metastable configuration. The authors apply their results to the problem of quantum tunneling of a pancake vortex from a columnar defect in the limit of a small driving current.

Pancake vortices in stacks of thin superconducting films or layers have been considered by R. G. Mints (Tel Aviv) et al. The authors find that in the absence of Josephson coupling, topological restrictions upon possible configurations of vortices are removed, and various structures forbidden in bulk superconductors can occur. In particular, the authors show that vortices may skip surface layers in samples of less than a certain size $R_c$, which might be macroscopic. Josephson coupling suppresses the $R_c$ estimates.

*At $T << T_c$,* the flux-flow voltage in the cuprate superconductor *$Nd_{2-x}Ce_xCuO_4$* shows an intrinsic step structure, also leading to negative differential resistivity. R. P. Huebener (Tübingen) et al. explain this in terms of subbands between the Fermi energy and the gap energy affecting the quasiparticle dynamics. In the presence of the electric field generated by current-induced vortex motion, the quasiparticle energy can be shifted to the upper band edge, resulting in Bragg reflection and Bloch oscillations. The subbands originate from the Andreev bound states in the vortex core via the interaction between vortices.

*Local* ac screening measurements in *YBCO* single crystals with twin boundaries have been carried out by G. A. Jorge and E. Rodríguez (Buenos Aires). For applied fields along the c direction, the authors found that at high temperatures, the twin boundaries serve as barriers to flux motion and thus enhance vortex pinning. At low temperatures, however, the twin boundaries act as channels for easy vortex motion.

The angular dependence of the in-plane resistivity $\rho(T,H,\theta)$ of melt-textured *$YBa_2Cu_3O_{7-\delta}/Y_2BaCuO_5$* composites has been measured by T. Puig (Barcelona) et al. over a wide range of magnetic fields and temperatures. From the results, the authors identify a new region in the vortex-liquid state where twin-boundary pinning defines a partially entangled liquid vortex state characterized by short-range c-axis vortex coherence.

*Three* preprints by Yu. A. Genenko (Göttingen and Donetsk) et al. report calculations of the current-density and magnetic-flux distributions in a superconducting strip surrounded by soft magnetic material with a high magnetic permeability. The authors show that the current-density distribution is strongly affected by the shape of the magnetic surroundings. Depending upon the geometry, this effect may either suppress the total transport critical current of the strip or else enhance it up to magnitudes much larger than the critical current of the isolated strip.

A preprint by M.A.R. LeBlanc (Ottawa) et al. reports on measurements of the evolution of the magnetization <M> upon warming from $T_0$ (4.2 K or 77 K) to $T_c$ for type-II superconductors *[$Nb_3Zr$, VTi, Nb, YBCO,* and *(Bi,Pb)-2223],* when <M> initially lies along one of the bridges between the envelopes of the field-increasing and field-decreasing magnetization curves. Oppositely directed magnetic moments coexist when <M> lies along the bridges, and when <M> is zero before warming, the two moments exactly cancel. However, since the two moments diminish in magnitude at different rates as T is increased to $T_c$, their sequential release leads to a rich variety of phenomena. The authors show that a simple model exploiting the critical state, an equilibrium Meissner current, and conservation of magnetic flux accounts for all the intricate behavior observed.

*A preprint* by A. A. Zhukov (Southampton and Moscow State) et al. reports the observation of a negative dynamic creep rate, i.e., increasing irreversibility in the magnetic hysteresis loop for decreasing sweep rate of the magnetic field, in both *$YBa_2Cu_3O_{7-\delta}$* and 2H-*$NbSe_2$* single crystals.

This phenomenon was found to appear on the increasing branch of the peak effect, which corresponds to a state that is intermediate between the dislocation-free Bragg glass and a highly disordered vortex phase. The authors show that the origin of the anomalous creep is connected to a negative differential resistance resulting from the N-like shape of the current-voltage characteristics.

*Measurements* in the peak-effect regime in a single crystal of $Ca_3Rh_4Sn_{13}$ have been carried out by S. Sarkar (TIFR-Mumbai) et al. using ac susceptibility and dc magnetization. Two discontinuous first-order-like transitions were found to occur, one near the onset of the peak effect and the other near the peak position. The authors attribute this to a stepwise fracturing or amorphization of the vortex lattice.

# Theory

*The quasiparticle* resonant states around a single nonmagnetic impurity with unitary scattering in a d-wave superconductor have been studied by J.-X. Zhu (TCSUH) et al., who solved the Bogoliubov-de Gennes equations based on a t-J model. The authors investigated both the spatial variation of the order parameter and the local density of states (LDOS) around the impurity. The authors found that: (a) A particle-hole-symmetric system has a single symmetric zero-energy peak in the LDOS regardless of the size of the superconducting coherence length $\xi_0$. (b) For the particle-hole-asymmetric case, an asymmetric splitting of the zero-energy peak is intrinsic to a system with a small value of $k_F\xi_0$, in qualitative agreement with the experimental results of A. Yazdani et al., Phys. Rev. Lett. **83**, 176 (1999).

Using a path-integral formulation, Q.-H. Wang (Nanjing) and Z. D. Wang (Hong Kong) have derived microscopically a Ginzburg-Landau free energy with Zeeman coupling between the magnetic field and the orbital angular momentum of the Cooper pairs in a superconductor with singlet pairing in the dominant $d_{x^2-y^2}$ and subdominant $d_{xy}$ channels. With Zeeman coupling and the Doppler energy shift due to the moving superfluid for quasiparticle excitations, the authors arrive at a coherent interpretation of two recent experiments on the thermal conductivity in *Bi-2212* [K. Krishana et al., Science **277**, 83 (1997), and H. Aubin et al., Phys. Rev. Lett. **82**, 624 (1999)].

*Functional*-integral techniques have been used by J. P. Wallington and J. F. Annett (Bristol) to examine the nearest-neighbor attractive Hubbard model on a quasi-2D lattice. This is a simple phenomenological model for the high-$T_c$ cuprates that allows both extended (nonlocal) s- and d-wave singlet superconductivity and mixed-symmetry states. Including Gaussian fluctuations, the authors examine the crossover from weak-coupling BCS superconductivity to the strong-coupling Bose-Einstein condensation of composite s- or d-wave bosons, and they comment on the origin and symmetry of the pseudogap.

*Using* numerical diagonalization of a $4 \times 4$ cluster, L. Arrachea (Buenos Aires) and A. A. Aligia (Bariloche) have calculated on-site s, extended s, and $d_{x^2-y^2}$ pairing correlation functions (PCF) in an effective generalized Hubbard model for the cuprates, with nearest-neighbor correlated hopping and next-nearest-neighbor hopping t'. The authors find that the vertex corrections to the PCF are significantly enhanced relative to the t-t'-U model. The behavior of the PCF and their vertex corrections, as well as signatures of anomalous flux quantization, indicate superconductivity in the d-wave channel for moderate doping and in the s-wave channel for high doping and small U.

The extended one-dimensional Hubbard model with attractive on-site interaction U and nearest-neighbor repulsion V has been considered by A. A. Aligia (Bariloche). The author constructs an effective Hamiltonian $H_{eff}$ for hopping $t << V$ and arbitrary $U < 0$. Retaining the most important terms, the author finds that $H_{eff}$ can be mapped onto two XXZ models, solved by the Bethe Ansatz. The quantum phase diagram shows two Luttinger-liquid phases and a region of phase separation between them. For some parameters, the results are in qualitative agreement with experiments in $Ba_{1-x}K_xBiO_3$.

*A scheme* for investigating the quantum dynamics of interacting electron models by means of a time-dependent variational principle and spin-coherent states of space lattice operators is proposed in a preprint by A. Montorsi and V. Penna (Torino). The authors apply this scheme to the one-dimensional Hubbard model, and they solve the resulting equations in different regimes. In particular, they find that at low densities the dynamics is mapped into two coupled nonlinear Schrödinger equations, whereas near half filling the model is described by two coupled Josephson-junction arrays.

A preprint by Y. Hasegawa (Himeji Institute of Technology) et al. selects a number of possible odd-parity states group theoretically and examines these in light of recent experiments on $Sr_2RuO_4$. The most plausible candidates are time-reversal-symmetry broken states with line nodes running either vertically or horizontally, consistent with experiments. The authors propose experiments to distinguish between these states.

# Overviews

*A book* chapter on Raman scattering in high-$T_c$ superconductors has been prepared by M. Cardona (MPI-Stuttgart). The author notes that the cuprates can be used to illustrate many techniques and applications of Raman spectroscopy.

In this chapter, the author reviews the theory and the main experimental results concerning Raman light scattering by phonons, electrons, and magnons in the high-$T_c$ superconductors and related materials (182 refs.).

*An introduction* to the electronic structure of high-$T_c$ superconductors is given in a review by J. Fink et al. (Dresden). The authors discuss recent studies of model compounds containing copper-oxide planes, ladders, and chains, performed using high-energy spectroscopies such as photoemission, x-ray absorption, and electron energy-loss spectroscopy (48 refs.).

Some insights regarding the path to higher $T_c$ in cuprate superconductors are given in a preprint by J. D. Jorgensen (Argonne): (1) For a given compound, the maximum $T_c$ is achieved by using a chemical variable to optimize the carrier concentration. (2) When different compounds are compared at their optimum doping, the highest $T_c$ is observed for compounds with flat $CuO_2$ planes. (3) $T_c$ also can be enhanced if the charge reservoir region (blocking layer) is metallic. The author notes, however, that these three criteria generally cannot be met simultaneously by adjusting a single chemical or structural variable. Nevertheless, the author argues that further increases in $T_c$ at ambient pressure should be possible, since a $T_c$ of over 160 K has been achieved at high pressure in the $HgBa_2Ca_2Cu_3O_{8+\delta}$ *(Hg-1223)* compound, which has buckled planes (19 refs.).

*An overview* of *U*/n processing has been prepared by R. Weinstein (TCSUH). Adding uranium to HTS powders before texturing, and irradiating with thermal neutrons n after texturing, produces effective pinning centers and high $J_c$s for a variety of HTS systems. Fission of $^{235}U$ produces two high-energy high-Z ions, leaving tracks of aligned quasi-columnar defects, which act as strong pinning centers. The author discusses results of *U*/n processing in *Y-123, Nd-123, Bi-2223/Ag* tapes, and other HTS systems (15 refs.).

# Ph.D. Theses

*Vortex* dynamics and the vortex-lattice phase diagram in $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* single crystals were studied in the Ph.D. thesis of B. Khaykovich (Weizmann Institute). The author found that samples with small critical current density in the central region and high critical current density at the edges exhibited peculiar flux distributions across the sample and unusual hysteresis loops. From studies of unirradiated crystals and those irradiated by electrons or heavy ions, the author concluded that vortex matter displays at least three distinct phases: (a) a relatively ordered quasilattice at low fields, (b) a highly disordered entangled vortex solid at fields above the second magnetization peak, and (c) a liquid phase at high temperatures. The author also carried out studies of the vortex-lattice melting transition as a function of the angle of the applied magnetic field for *Bi-2212* crystals containing columnar defects (207 refs.).

*Studies* of vortex dynamics and the vortex-matter phase diagram in high-temperature superconductors also are reported in the Ph.D. thesis of D. Fuchs (Weizmann Institute). The author carried out simultaneous Hall-sensor measurements of magnetic fields and electrical transport in *Bi-2212* single crystals and found that the first-order phase transition of the vortex matter displays both a magnetization step and a resistance drop. Flux-transformer measurements performed close to $T_c$ provided evidence that the first-order transition is a sublimation transition. Other experiments probing the current distribution revealed that many of the transport measurements in *Bi-2212* probe the physics of surface barriers rather than the physics of bulk superconductors (189 refs.).

The Ph.D. thesis of P. Vanderbemden (Liège) reports studies of the critical current density in bulk high-temperature superconductors as determined by magnetic-flux-profile measuring methods. The author presents (a) a theoretical discussion of flux-profile methods, (b) a description of a practical realization of an experimental set-up intended for measuring such flux profiles, and (c) a discussion of flux-profile measurements in several bulk high-temperature superconductors, including *Y-123, Bi-2212,* and *Bi-2223* sintered ceramics and polycrystalline textured *Bi-2212* and *Dy-123* (207 refs.).

*The Houston* Ph.D. thesis of W. Hennig describes how, by using $YBa_2Cu_3O_{7-\delta}$ superconductors cooled to 77 K in the uniform 2.3 T field of an electromagnet, magnetic levitation forces can be increased above those produced by permanent magnets. The maximum trapped field at 77 K was 1.6 T, considerably higher than the field of 0.5 T that would be produced by commonly used permanent ferromagnets of the size used in this work. The author studied a number of levitation arrangements, measured force-distance curves, and fitted these to phenomenological models based on Bean's flux-pinning model (53 refs.).

Contributed by John R. Clem

*Contents:* 

***High-$T_c$ Update* is available without charge to interested persons. Recipients are expected to participate in this information exchange by sending us preprints, reprints, meeting news, research news, etc. Contributions to defray the cost of newsletter printing and mailing are welcome.**

*High-$T_c$ Update,* Nov. 1, 1999

# 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.**

*The new* Australian Superconductors HTS plant (a division of Metal Manufactures Limited) announced relocation of their high-temperature-superconductor manufacturing pilot plant from the Australian Technology Park in Sydney, into a new expanded facility on the recently opened Engineering Innovation and Education Centre (EIEC) at the University of Wollongong. The new facility will occupy 850 $m^2$ and allow Australian Superconductors to scale-up production capacity for its state-of-the-art HTS tape, which includes tape made with different sheath alloys and with tailored number and geometry of HTS filaments. The HTS tape is optimized for minimal thermal and ac loss and maximum mechanical strength, and developed specifically for each defined application. The new plant will also increase the capability of Australian Superconductors to manufacture and test its expanding range of HTS products such as coils and current leads. The move to the EIEC is a key part of the commercialization strategy since, earlier this year, Metal Manufactures Ltd. signed an exclusive contract with the University to jointly develop HTS tape and devices over the next three years. For further information, contact Tim Beales, Manager, Australian Superconductors, P.O. Box 21, Gloucester Boulevard, Port Kembla, NSW 2505, Australia; telephone +61 2 4221 5725; telefax +61 2 4221 5731; e-mail tb1960@msn.com.au; Web site http://www.superconductors.com.au.

Contributed by Sreeparna Mitra

# PREPRINTS

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**A. A. Aligia**, "Phase Diagram of the One-Dimensional Extended Attractive Hubbard Model for Large Nearest-Neighbor Repulsion." Submitted to Phys. Rev. B. Centro Atómico Bariloche and Instituto Balseiro, Comisión Nacional de Energía Atómica, 8400 Bariloche, ARGENTINA; e-mail aligia@cab.cnea.gov.ar.

**A. A. Aligia and Liliana Arrachea**, "Triplet Superconductivity in Quasi One-Dimensional Systems." To be published in Phys. Rev. B. Centro Atómico Bariloche and Instituto Balseiro, Comisión Nacional de Energía Atómica, 8400 Bariloche, ARGENTINA; e-mail aligia@cab.cnea.gov.ar.

**Liliana Arrachea and A. A. Aligia**, "Pairing Correlations in a Generalized Hubbard Model for the Cuprates." Submitted to Phys. Rev. Lett. Contact A. A. Aligia, Centro Atómico Bariloche and Instituto Balseiro, Comisión Nacional de Energía Atómica, 8400 Bariloche, ARGENTINA; e-mail aligia@cab.cnea.gov.ar.

**P. Barbara, F. M. Araujo-Moreira, A. B. Cawthorne, and C. J. Lobb**, "Reentrant ac Magnetic Susceptibility in Josephson-Junction Arrays: An Alternative Explanation for the Paramagnetic Meissner Effect." To be published in Phys. Rev. B. Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, MD 20742-4111; e-mail paola@squid.umd.edu; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9910088.

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**P. S. Czerwinka, R. P. Campion, K. F. Horbelt, P. J. King, S. Misat, S. M. Morley, H.-U. Habermeier, and B. Leibold**, "Investigations of the In-Plane Anisotropy and the Critical Behavior of 10°-Tilted $YBa_2Cu_3O_{7-\delta}$ Films Grown Upon (106) $SrTiO_3$ Substrates." To be published in Physica C (in press). Contact P. J. King, Department of Physics, School of Physics and Astronomy, University of Nottingham, University Park, Nottingham NG7 2RD, UNITED KINGDOM; telephone +44 115 951 5164; telefax +44 115 951 5184; e-mail p.j.king@nottingham.ac.uk. Key words: *YBCO,* miscut, dissipation, anisotropy, scaling, vortex glass.

**J. Figueras, A. E. Carrillo, T. Puig, and X. Obradors**, "Solubility Limit and Anisotropy Analysis of *Mg* Doping in Melt Textured $YBa_2(Cu_{1-x}Mg_x)_3O_{7-\delta}$." To be published in J. Low Temp. Phys. Institut de Ciència de Materials de Barcelona, C.S.I.C., Campus de la Universitat Autònoma de Barcelona, E-08193 Bellaterra, SPAIN; telephone +34 93 580 1853; telefax +34 93 580 5729. 74.72.Bk; 74.62.Bf; 74.60.Ec.

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**D. A. Gorokhov and G. Blatter**, "Hall Tunneling of Vortices in Superclean Superconductors." Theoretische Physik, ETH-Hönggerberg, CH-8093 Zürich, SWITZERLAND; e-mail gorokhov@itp.phys.ethz.ch; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9907469.

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**Wolfgang Hennig**, "Increase of Force in Magnetic Levitation by Using Field Cooled $YBa_2Cu_3O_{7-\delta}$ Trapped Field Magnets Instead of Ferromagnets." Submitted as a Ph.D. thesis (University of Houston). University of Houston, 632 SR1, Houston, TX 77204-5506; telephone (713) 743-3600; telefax (713) 747-4526; e-mail whennig@bayou.uh.edu.

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with a Wide Solubility Range and High *Cu* Valence." To be published in J. Supercond. 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. Key words: layered compounds, 8-8-20, x-ray diffraction, electrical properties.

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**V. M. Krasnov, N. Mros, A. Yurgens, and D. Winkler**, "Flux-Flow Branches and Fiske Steps in *Bi-2212* Mesas." Submitted to Physica B: Proc. of the 22nd Int. Conf. on Low Temp. Phys. (LT22), Helsinki, Finland, Aug. 5-11, 1999. Department of Microelectronics and Nanoscience, Chalmers University of Technology, S-41296 Göteborg, SWEDEN; telephone +46 31 772 3397; telefax +46 31 772 3471; e-mail krasnov@fy.chalmers.se; Web site http://fy.chalmers.se/~krasnov/.

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**M. T. Malachevsky and D. A. Esparza**, "Metal-Ceramic Interface Response to Bending and Fatigue Cycles in Superconducting *Ag-Bi2223* Composites." To be published in Physica C. Complejo Tecnológico Pilcaniyeu, Comisión Nacional de Energía Atómica, Av. Bustillo 9500, 8400 San Carlos de Bariloche, ARGENTINA; e-mail malache@cab.cnea.gov.ar. Key words: *Ag-Bi2223* composites, bending cycles, fatigue, cracks formation. 74.72.Hs; 74.25.Ld; 62.20.Mk; 74.60.Jg.

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Vladimir G. Kogan, Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, IA 50011-3020; telephone (515) 294-8080; telefax (515) 294-0689; e-mail kogan@ameslab.gov; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9910063. 74.60.-w; 74.80.Dm.

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**V. Selvamanickam, G. Galinski, G. Carota, J. DeFrank, C. Trautwein, P. Haldar, U. Balachandran, M. Chudzik, J. Y. Coulter, P. N. Arendt, S. R. Foltyn, B. Newnam, and D. E. Peterson**, "High-Current *Y-Ba-Cu-O* Conductor by Metal Organic Chemical Vapor Deposition on Metal Substrates." Submitted to Supercond. Sci. & Technol. Intermagnetics General Corporation, Latham, NY 12110; preprint also available from Janice Coble, Materials Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439; telephone (630) 252-5497; telefax (630) 252-9595; e-mail coble@anl.gov. Key words: *YBCO,* superconductor, MOCVD, IBAD, current density.

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**N. Vasanthamohan, T. B. Peterson, J. P. Singh, V. K. Vlasko-Vlasov, U. Welp, M. T. Lanagan, and G. W. Crabtree**, "Effect of Core Inhomogeneity on Strain Tolerance of *Bi-2223* Composite Conductors." Submitted to J. Appl. Phys. Contact Janice Coble, Materials Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439; telephone (630) 252-5497; telefax (630) 252-9595; e-mail coble@anl.gov.

**J. P. Wallington and James F. Annett**, "BCS to Bose Crossover in Anisotropic Superconductors." H. H. Wills Physics Laboratory, University of Bristol, Royal Fort, Tyndall Avenue, Bristol BS8 1TL, UNITED KINGDOM; e-mail jon.wallington@bristol.ac.uk; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9909043.

**Qiang-Hua Wang and Z. D. Wang**, "Zeeman Coupling and Abnormal Thermal Conductivities in *BSCCO* Superconductors." Department of Physics and National Laboratory of Solid State Microstructures, Nanjing University, Nanjing 210093, PEOPLE'S REPUBLIC OF CHINA; e-mail qhwang@bohr.physics.hku.hk; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9909399. 74.20.De; 74.25.Fy; 74.60.Ec.

**Roy Weinstein**, "An Overview of *U*/n Processing." Presented at the 12th Int. Symp. on Superconductivity (ISS'99), Morioka, Japan, Oct. 17-19, 1999. Department of Physics and Texas Center for Superconductivity, University of Houston, Houston, TX 77204-5506; phone (713) 743-8200; fax (713) 743-8201; e-mail preprints@www.tcs.uh.edu. Key words: pinning centers, high $J_C$, high $H_{irr}$, isotropy, fission damage.

**W. Wong-Ng, J. P. Cline, L. P. Cook, and W. Greenwood**, "X-ray Characterization of Compounds in the *SrO-PbO* System." To be published in Adv. X-ray Anal. A256 MATLS, National Institute of Standards and Technology, Gaithersburg, MD 20899; telephone (301) 975-5791; telefax (301) 975-5334; e-mail winnie.wong-ng@nist.gov.

**W. Wong-Ng and L. P. Cook**, "Melting Equilibria of the *2223 [(Bi,Pb)-Sr-Ca-Cu]* High $T_C$ Superconductor in Oxygen." Submitted to Ceramics Transaction. A256 MATLS, National Institute of Standards and Technology, Gaithersburg, MD 20899; telephone (301) 975-5791; telefax (301) 975-5334; e-mail winnie.wong-ng@nist.gov.

**W. Wong-Ng, L. P. Cook, W. Greenwood, and A. Kearsley**, "Effect of *Ag* on the Primary Phase Field of High $T_C$ *(Bi,Pb)-2223* Superconductor." Submitted to J. Mater. Res. A256 MATLS, National Institute of Standards and Technology, Gaithersburg, MD 20899; phone (301) 975-5791; fax (301) 975-5334; e-mail winnie.wong-ng@nist.gov.

**W. Wong-Ng, J. Dillingham, and L. P. Cook**, "Phase Relations of the $SrO$-$Ho_2O_3$-$CuO_X$ System." To be published in J. Solid State Chem. A256 MATLS, National Institute of Standards and Technology, Gaithersburg, MD 20899; telephone (301) 975-5791; telefax (301) 975-5334; e-mail winnie.wong-ng@nist.gov.

**W. Wong-Ng, J. A. Kaduk, W. Greenwood, and J. Dillingham**, "Powder X-ray Reference Patterns of $Sr_2RGaCu_2O_7$ *(R=Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm, Yb* and *Y)*." To be published in J. Res. Nat. Inst. Stand. Technol. A256 MATLS, National Institute of Standards and Technology, Gaithersburg, MD 20899; telephone (301) 975-5791; telefax (301) 975-5334; e-mail winnie.wong-ng@nist.gov.

**Z. A. Xu, N. P. Ong, T. Noda, H. Eisaki, and S. Uchida**, "Anisotropic Effect of Field on the Orthorhombic-to-Tetragonal Transition in the Striped Cuprate $(La,Nd)_{2-x}Sr_xCuO_4$." Submitted to Europhys. Lett. Joseph Henry Laboratories of Physics, Princeton University, Princeton, NJ 08544; e-mail zhuan@princeton.edu; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9910123.

**Jiro Yamada, V. V. Srinivasu, Masaki Tada, Ken-ichi Itoh, Akinori Hashizume, Ikutaro Kometani, Khairil Anwar, and Tamio Endo**, "Influence of dc Field Sweep Rate on Non-Resonant Microwave Absorption in a $YBa_2Cu_3O_X$ Superconductor." Presented at the 12th Int. Symp. on Superconductivity (ISS'99), Morioka, Japan, Oct. 17-19, 1999. Contact Tamio Endo, Department of Electrical and Electronic Engineering, Mie University, 1515 Kamihama, Tsu 514, JAPAN; telephone +81 592 32 1211; telefax +81 592 31 9471; e-mail endo@cm.elec.mie-u.ac.jp. Key words: microwave absorption, $YBa_2Cu_3O_X$ superconductor, vortex dynamics.

**A. Yamamoto, T. Furumochi, and S. Tajima**, "Metal-Insulator Transition and Superconductivity in *Sr* and *La* Substituted $BaPb_{1-x}Bi_xO_3$." To be published in Physica C. Superconductivity Research Laboratory, International Superconductivity Technology Center (ISTEC), 10-13 Shinonome 1-chome, Koto-ku, Tokyo 135-0062, JAPAN; telefax +81 3 3536 5714; e-mail yamamoto@istec.or.jp. Key words: superconductivity, metal-insulator transition, transport properties, *BPBO.*

**In-Sang Yang, M. V. Klein, S. L. Cooper, P. C. Canfield, B. K. Cho, and Sung-Ik Lee**, "A Study of the Superconducting Gap in $RNi_2B_2C$ *(R=Y,Lu)* Single Crystals by Inelastic Light Scattering." Materials Research Laboratory, Department of Physics, University of Illinois at Urbana-Champaign, Urbana, IL 61801; e-mail iyang@uiuc.edu; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9910087. Key words: borocarbide superconductors, superconducting gap, electronic Raman scattering. 78.30.Er; 74.70.Dd; 74.25.Jb.

**Y. G. Zhao, M. Rajeswari, R. C. Srivastava, Z. W. Dong, R. P. Sharma, and T. Venkatesan**, "Growth and Electrical Properties of $PrSr_2Cu_3O_{7-\delta}$ Thin Films." To be published in Physica C (in press). Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, MD 20742; phone (301) 405-7654; fax (301) 405-3779; e-mail yzhao@squid.umd.edu. Key words: $PrSr_2Cu_3O_{7-\delta}$, PLD, thin films. 74.72.Bk; 74.25.Fy; 74.76.-w.

**Jian-Xin Zhu, T. K. Lee, C. S. Ting, and Chia-Ren Hu**, "Unified Theory of Quasiparticle Resonant States Induced by a Unitary Impurity in a d-Wave Superconductor." Department of Physics and Texas Center for Superconductivity, University of Houston, Houston, TX 77204-5932; phone (713) 743-8276; fax (713) 743-8201; e-mail jxzhu@mira.tcs.uh.edu; preprint also available at http://xxx.lanl.gov/abs/cond-mat/9909363. 74.25.Jb; 74.50.+r; 73.20.Hb.

**A. A. Zhukov, S. Kokkaliaris, P.A.J. de Groot, M. J. Higgins, S. Bhattacharya, R. Gagnon, L. Taillefer**, "Negative Dynamic Creep in the Peak-Effect Regime in Type II Superconductors." Submitted to Phys. Rev. Lett. Department of Physics and Astronomy, University of Southampton, Southampton SO17 1BJ, UNITED KINGDOM; phone +44 1703 592077; fax +44 1703 593910; e-mail aaz@phys.soton.ac.uk. 74.60.Ge; 74.60.Jg; 74.72.Bk.

**Marco Zoli**, "Dispersive Holstein Model: Which Mass for the Small Polaron?" To be published in Physica C (in press). Dipartimento di Matematica e Fisica, Istituto Nazionale di Fisica della Materia, Universitá di Camerino, Via Madonna delle Carceri, I-62032 Camerino, ITALY; telefax +39 0737 40042; e-mail zoli@campus.unicam.it. Key words: high-$T_c$ superconductivity, polaron mass, electron-phonon coupling. 71.38.+i; 71.28.+d; 74.20.Mn; 74.25.Kc.

# *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.)*

## *March 13 - 17, 2000:* 18th General Conference of the Condensed Matter Division of the European Physical Society (EPS CMD18-2000), Montreux, Switzerland. Conference will consist of plenary and invited talks, mini colloquia, and poster sessions on topics covering condensed-matter physics. Format will be similar to that of the last EPS-CMD17 conference in Grenoble (1998). The program of each mini colloquium is organized by its respective chairpersons. No proceedings will be published. Will include exhibition of scientific instruments and books. **Abstract deadline, November 15, 1999.** For information, contact Conference Secretariat CMD18-2000, Laboratorium für Festkörperphysik, ETH Hönggerberg, CH-8093 Zürich, Switzerland; e-mail eps-cmd18@psi.ch; Web site www.eps-cmd18.ch.

## **March 20 - 24, 2000:* 2000 March Meeting, Minneapolis Convention Center, Minneapolis, Minn. Sessions on superconductivity will include the following topics: synthesis, growth, and processing (bulk and films); thermodynamic and transport properties; mechanical and structural properties; electronic structure and spectroscopic properties; flux pinning and flux dynamics; spin properties (NMR, NQR, etc.); tunnel junctions, devices, and Josephson arrays; quantum computing; and other focused sessions. **Abstract deadline, December 3, 1999.** (Complete abstract submission instructions can be found at http://www.aps.org/meet/meet-abstract.html.) For further general information, contact Donna Baudrau, Manager, APS Meetings Department, telephone (301) 209-3285, e-mail baudrau@aps.org; more information on the March meeting is available at the Web site http://www.aps.org/meet/MAR00/.

## **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. 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 on phenomena related to nanoscale phase separation and charge modulation. Symposium on Itinerant and Localized States in HTSC (SILS) will focus on large and small polaron and bipolaron effects in high-$T_c$ materials with special emphasis on their preparative properties. MTSC 2000 is organized in close analogy to the Gordon conferences. Limited number of slots for posters. Total number of participants limited to 130 persons. Proceedings will be published in a special issue of *Journal of Superconductivity.* **Abstract and pre-registration deadline, November 15, 1999.** For more information, contact Annette Bussmann-Holder, Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, D-70569 Stuttgart, Germany; telephone +49 711 689 1679;

telefax +49 711 689 1091. Or contact Vladimir Z. Kresin, Lawrence Berkeley Laboratory, University of California, 1 Cyclotron Road, Berkeley CA 94720; telephone (510) 486-6951; telefax (510) 486-5401. Information also available at Web site http://www.mpi-stuttgart.mpg.de/CONF/mtsc2000.html.

## *April 24 - 28, 2000:

Superconducting and Related Oxides – Physics and Nanoengineering IV, Marriott's Orlando World Center Resort and Convention Center, Orlando, Fla. Part of SPIE's 2000 AeroSense Symposium. Fourth in the series of SPIE conferences focused on basic issues in physics and materials science of high-temperature superconductors and related compounds that may be relevant for their applications in electronics, optics, and optoelectronics. Topics are: a) structural, transport, magnetic, and thermal properties of thin films of cuprates and related compounds; b) homoepitaxy, new substrate materials, epitaxial and morphological properties, interface smoothness and disorder, layer thickness fluctuations, interdiffusion, and strain; c) proximity effects, surface and interface effects, and superconductors in contact with insulators, semiconductors, normal metals, ferro- and antiferromagnets, piezoelectrics, etc.; d) search for novel high-temperature superconducting phases by atomic engineering; e) electronic structure, charge redistribution, localization, single-particle and collective excitations, and Josephson phenomena in natural and artificial superlattices; f) novel device concepts, electric field effect in heterostructures, hybrid optoelectronic devices, and cryoelectronics. Three-day exhibition. Proceedings to be published. Contact SPIE, P.O. Box 10, Bellingham, WA 98227-0010; telephone (360) 676-3290; telefax (360) 647-1445; e-mail OR@spie.org; Web site http://www.spie.org/web/meetings/calls/or00/confs/OR15.html.

## *April 30 - May 3, 2000:

102nd Annual Meeting & Exposition Gateway to the New Millennium, St. Louis, Mo. This is the premier international forum for ceramics. Comprehensive coverage of ceramic and materials science, engineering, technology, manufacturing, and applications. The program will include symposia and focused programs: the symposia are designed to provide multidisciplinary perspectives on the nature and impact of state-of-the-art ceramic science, engineering, and technology in key areas, and the focused programming provides forums for in-depth technical exchange on specialized topics. Symposia will include ceramics and integrated components in microelectronics, optoelectronics, wireless communications and consumer electronics; ceramics for biological, chemical, mechanical, thermal and high-radiation applications; processing of ceramics; and cross-cutting symposia. **Abstract deadline, November 15, 1999.** For information, contact The American Ceramic Society, P.O. Box 6136, Westerville, OH 43086-6136; telephone (614) 890-4700; telefax (614) 899-6109; e-mail info@acers.org; Web site http://www.acers.org/.

## *June 18 - 23, 2000:

European Conference on Energy Dispersive X-Ray Spectrometry (EDXRS 2000), Kraków, Poland. Aim of the conference is to bring together scientists working either in basic research in x-ray spectrometry, detectors and sources, or involved in applications of x-ray spectrometry or some of the related experimental techniques. Main topics: interaction of photons and particles with matter and modeling; new developments in instrumentation (instruments utilizing polarized radiation, synchrotron radiation and other x-ray sources, grazing angle spectrometers, portable instruments); energy dispersive x-ray detectors (cryo-detectors, low-Z detectors, Peltier-cooled detectors, dedicated pulse processing); quantitation and data handling (sample preparation, quality control and quality assurance, simulation, modeling, software); x-ray optics (capillaries, mirrors, multilayers, TXRF, imaging); microanalysis and elemental mapping (micro-XRF, micro-PIXE, EPMA); and x-ray spectrometry applications in life and environmental sciences, earth sciences, art and cultural heritage, material sciences, and industry. **Pre-registration deadline, November 15, 1999; abstract deadline, March 1, 2000.** The official language of the conference is English. For information, contact EDXRS-2000 Secretariat, Faculty of Physics and Nuclear Techniques, University of Mining and Metallurgy, Al. Mickiewicza 30, 30-059 Kraków, Poland; telefax +48 12 6340010; Web site http://www.ftj.agh.edu.pl/wfitj/conf/edxrs/.

# RESOURCES

## Information

## Proceedings:

*High Temperature Superconductivity* – proceedings of the 1999 University of Miami Conference, Coral Gables, Florida, January 7-13, 1999, edited by Stewart E. Barnes, Joseph Ashkenazi, Joshua Cohn, and Fulin Zuo. AIP Conference Proceedings 483. Physical properties, microscopic theory, mechanisms for high-temperature superconductivity, and related topics (e.g., ladders, manganites, nickelates) are covered. Recent important experimental and theoretical developments in high-temperature superconductivity are discussed. Publ. 1999; 450 pp.; price $130; ISBN 1-56396-880-0. For U.S. orders, contact Springer-Verlag New York, P.O. Box 2485, Secaucus, NJ 07096; telephone (800) SPRINGER (777-4643); telefax (201) 348-4505. For orders outside the U.S. and Canada, contact Springer-Verlag Berlin, P.O. Box 31 13 40, D-10643 Berlin, Germany; telephone +49 30 82787 0; telefax +49 30 82787 301; e-mail orders@springer.de.


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*High-$T_c$ Update* is published for the Office of Basic Energy Sciences, U.S. Department of Energy, under Contract W-7405-eng-82 with the Ames Laboratory, Iowa State University. Support is also provided by organizations listed on the masthead and by other donors. Please direct all inquiries to:

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Science Editor: John R. Clem
ISSN 1048-1141
Homepage: http://www.iitap.iastate.edu/htcu/htcu.html

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