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Cryogenic
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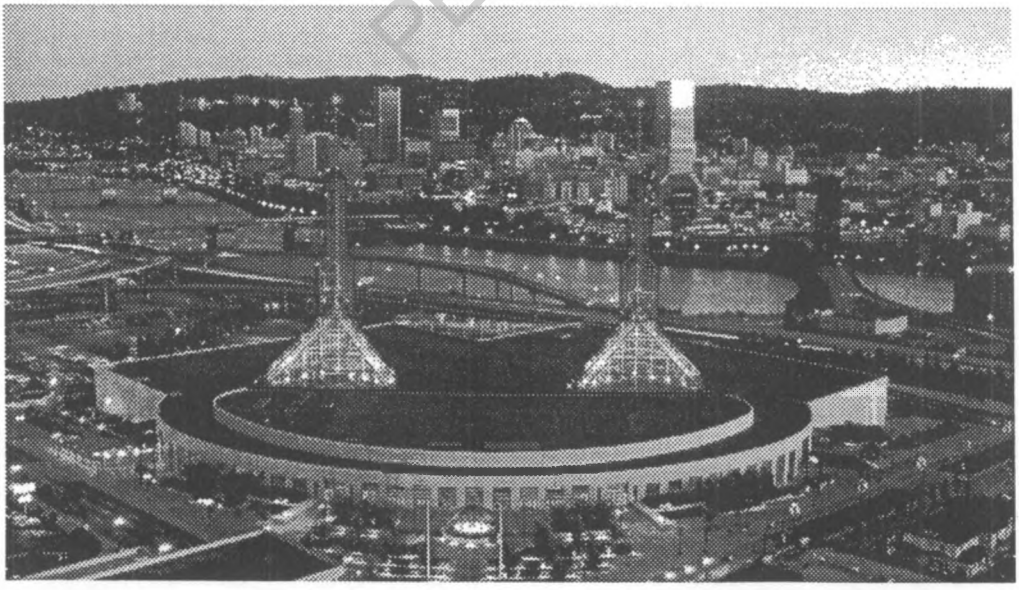
Conference

July 28th
thru
August 1st
1997

Oregon
Convention
Center
Portland, Oregon
U.S.A.

CONFERENCE ABSTRACTS



"Pioneering Development in Cryogenic Engineering and Materials"

APD-2

MQE MEASUREMENTS ON SINGLE STRANDS, P. Bauer, L. Oberli CERN/LHC/MMS, Geneva 23, Switzerland-Minimum Quench Energy MQE measurements are now well established in applied superconductivity. However the MQE measurement on cylindrical strands, especially in superfluid helium, still requires skills and the appropriate choice of the heater-technique. Within the frame of the LHC project a program has been initiated at CERN intending to raise the understanding of conductor-stability in superconducting accelerator magnets. The MQE gives some indication about the stability of superconductors against thermal disturbances of small extent and short duration. We base our experimental technique on the carbon paste heater method originally developed by K. Seo et al.. This paper will present the results of a test-program involving a series of strand-prototypes for the LHC. Particular emphasis will be put on the analysis of the results with respect to the differences in strand-design and coating under several operating conditions (4.2K/8T, 1.9K/11T). To facilitate the analysis a theoretical MQE-model based on the numerical solution of the one dimensional heat balance equation has been developed.

APD-3

THE OBSERVATION OF APPARENT SONIC RANGE VELOCITIES OF NORMAL ZONE PROPAGATION IN HIGH CURRENT DENSITY SUPERCONDUCTOR, Yu.D. Kuroedov, G.L. Dorofeev, RRC "Kurchatov Institute", Moscow 123182, V.L.Gershenkroy, M.G.Kremlev, V.E.Fortov, HEDRIC-IVTAN, Moscow 125681, Russia - The apparent sonic range velocities of normal zone propagation in high current density superconductor was observed. The experimental results were obtained on the samples 0.16 mm thickness and 65 mm length of the monofilamentary NbTi wire with critical current density Jc about 10^6 A/sm^2. The voltage increasing speed reached 1.5×10^7V/sec at transport current about 200 A, and correspondent normal zone propagation velocity exceed 5 ± 0.5 km/sec. So high velocity can be caused by the detonation-like propagation of normal phase in superconductor with high current density.

APD-4

ON EXCESSIVE RESISTANCE AND HEAT GENERATION OF ALUMINUM CONDUCTOR DUE TO MAGNETIC FIELD INHOMOGENEITY.* V.R.Sobol, O.N.Mazurenko and A.A.Drozd, Institute of Solid State and Semiconductor Physics, ASB, Minsk 220072, Belarus - Inhomogeneity of current distribution of high purity aluminum at 4.2 and 30 K is studied. One of major problem of cryogenic devices generating high magnetic field is an enhancement of magnetoresistance and respective heat generation due to inhomogeneity of composite conductor in the place of its interface and due to inhomogeneity of magnetic field through device's coils because inner and outer coils are at different magnitudes of magnetic field. Usually an include of magnetic field inhomogeneity into resistance increase is neglected. A paper proposed here is to show that at cryogenic temperatures the amount of excessive resistance connected with magnetic field inhomogeneity may be comparable in magnitude with traditional enhancement of resistance due to interface of composite conductors. The testing is done by measurement of potential distribution over conductors of 99.999% Al being under inhomogeneous magnetic field action at 4.2 K. The magnetic field gradient of 0.1 cm^{-1} is directed along current flow. On the other hand a calculation of nonuniform current distribution and enhancement of resistance due to decrease of effective conductor cross section is made on the base of experimental boundary conditions for electric potential. A correlation of experimental data with calculation is made and discussed for different low temperature range and purity of metal in quasi free electron approximation.

* Research is supported by Fund of Fundamental Investigations of the Republic of Belarus.

APD-5

ELECTRON SCATTERING PROCESSES ANISOTROPY IN AL-GA DILUTE ALLOYS IN STRONG MAGNETIC FIELDS, S.E.Demyanov, A.A.Drozd and A.V.Petrov, Institute of Solid State and Semiconductor Physics, ASB, Minsk 220072, Belarus - The present investigation is a part of work of search for cryoconducting material on the base of high pure Al, which displays optimal electrical and mechanical properties. In Al-Ga alloys the electron-impurity and electron-phonon scattering mechanisms in transverse magnetic fields up to 8T, and at helium-hydrogen temperatures were studied. The measurements were made on single crystals of some orientations. Ga alloying addition content was varied from 0.1 to 0.001 mass%, i.e. in the region which made it possible to retain RRR ≥ 1000. The deviation from Matthiessen's rule (DMR) was studied at two positions of magnetic field vector relative to axes of a crystal: the field was oriented near one of the main axes and 15-20° from it. The results obtained evidence correlation of DMR temperature dependence and magnetic field vector angular position. When the field is directed near the main axis, the DMR dependence has a complicated behavior with an extremum. At other field directions, the curves increase monotonically in the region of positive or negative values of the DMR.The data obtained were analyzed in terms of competition of two scattering mechanisms, one of which increases scale of the electron distribution function anisotropy in magnetic field, and the other suppresses it. Small-angle electron-phonon scattering, which increases scale of the anisotropy may be of umklapp or diffusion type. It is shown that the umklapp-type scattering is effective when electron orbits in magnetic field would pass through the "hot spots"on the Fermi surface. Diffusion electron-phonon scattering, i.e. random stray on electron orbits, is effective at magnetic field directions, which provide passage of electron from the Fermi surface section to equivalent one.

APD-6

THE ANISOTROPIC CHARACTERISTIC OF THE MAGNETIC STABILITY OF HIGH-Tc SUPERCONDUCTING PERMANENT MAGNETS UNDER DISTURBANCES,* Ming Qiu, Shuo Han, and Liangzhen Lin, Institute of Electrical Engineering, Academia Sinica, P.O.Box 2703, Beijing 100080, P.R.China - The changes of the trapped field in the axial (//c axis) and radial (//ab face) directions was measured simultaneously from 4.2K to 77.3K, when high-Tc superconducting (HTS) permanent magnets were subject to limited thermal disturbances and to low external AC fields, respectively. Experimental phenomena showed that the capability of HTS permanent magnets against disturbances has strong anisotropic characteristic, which changes with temperature and the magnitude of the trapped field. Combined with vortex dynamics and flux-pinning mechanism of HTSs, the results above and the anisotropic stability criterion of HTS permanent magnets were preliminarily discussed.

*The work is supported by the National Natural Science Foundation of China and the National Center for R & D on Superconductivity of China.

SESSION APE: Pulse Tube Coolers A.

Exhibit Hall

Ch: B. Burt CCh: P. Bradley

APE-1

DESIGN OF A LONG-LIFE AND LOW-COST 0.5 WATT MINIATURE PULSE TUBE COOLER, D.T.Kuo, A.S.Loc, and S.W.K.Yuan, BEI Sensors and Systems Company, Sylmar, CA 91342- The design of a 0.5 Watt Miniature Pulse Tube Cooler discussed in this paper is based on the analyses of a Hybrid Refrigeration Model (HRM) which is similar in nature to a third order model that has been validated extensively against various Stirling and Pulse Tube Coolers in the literature*. Together with BEI's experience with the linear Stirling refrigerators and the introduction of flexure bearings, the design of a long-life and low-cost cooler emerges. The cooler should have a lifetime of at least five years with high reliability and is capable of producing 0.5 Watt of cooling power at 80 Kelvin with a total input power of less than 15 Watt and with a cooler heat sink temperature of 310 Kelvin. The system should also deliver 0.3 Watt of cooling at 65 Kelvin with the same input power and heat sink temperature. The cooler is also light-weight, weighing less than 1 Kg.

* A Blind Test on the Pulse Tube Refrigerator Model (PTRM), S.W.K. Yuan and Ray Radebaugh, Advances in Cryogenic Engineering, Vol. 41B (1996) p.1383.