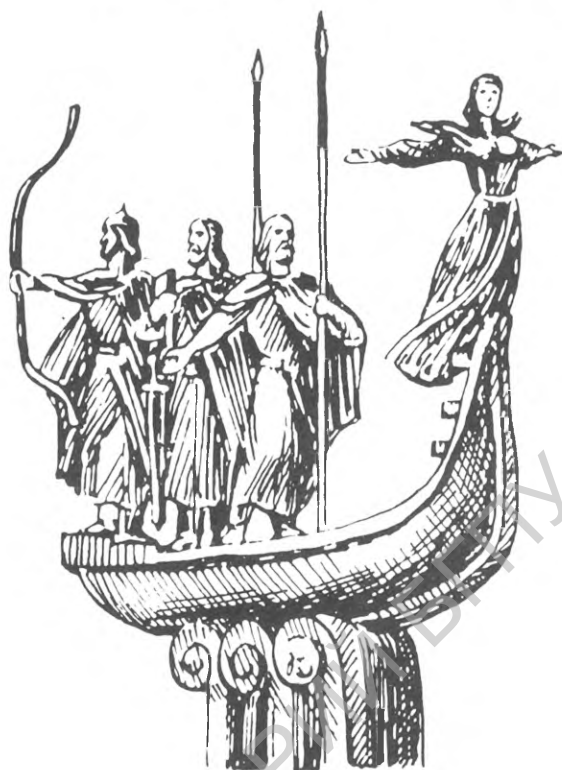


ICEC-14

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Ukraine

June 8—12

Program and abstracts

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plasticity slightly decreases, 90, at 77 K - $6 < 0,2$ in the alloys for which $m\bar{H} > 3$, but at 293 K in alloys with $m\bar{H} > 5$.

MC-GP35. DEFORMATION TEMPERATURE EFFECT ON SUPERCONDUCTING PROPERTIES OF YBCO-TYPE CERAMICS, Malyshev E. N., Shishkova N. V., Dugadco A. B., Shepel V. M. Mikheenko P. N., Yuzhelevskii Ya. I. Donetsk Physico-Technical Institute of the Ukrainian Academy Of Sciences, Donetsk, Ukraine—The work is intended to create superconductors (SC) on the basis of the 1-2-3 type HTSC ceramics in air-tight bronze shell. Initial material - commercial powder composed of two SC phases: low-temperature (LT) 60 K and high temperature (HT) 92 K in approximately equal proportions. Plastic deformation of billets was made in two ways: hydropressing and flattening at 78...930 K. Plastic deformation at room temperature resulted in broadening T_c , reduction of total volume of the SC phase with the simultaneous increase in the low-temperature phase. This trend grows with the deformation temperature (T_d) and at $T_d = 930$ K $T_c = 50$ K, and the SC phase is 3 % to the initial one. The deformation at low temperatures did not result in suppression of SC properties and at $T_d = 78$ K the HT step of the SC transition becomes more pronounced, the amount of SC phases is almost the same. Annealing promoted to recovery of the SC properties in all the specimens deformed at high temperatures with domination of the LT SC phase (80...90 %) and the diamagnetic response at the initial level. Resistive measurements of all annealed specimens revealed two-step transition with the zero resistance at $T = 50...65$ K. The critical current density is 100—300 A/cm² at $T = 2/3 T_c$.

MC-GP37. PHYSICAL PROPERTIES AND BAND SPECTRUM OF $Y_{1-x}Ca_xBa_2Cu_yO$, V. E. Gasumyants, V. I. Kaidanov, S. A. Kazmin, E. V. Vladimirovskaya, Technical University, St. Petersburg — Transport properties of $Y_{1-x}Ca_xBa_2Cu_yO$ ($x = 0, 0.05, 0.1, 0.15, 0.2, 0.25$) ceramic samples have been investigated as a function of Ca content and the number of oxygen vacancies. The temperature dependence of resistivity $\rho(T)$ and thermopower $S(T)$ analysis within narrow band model. earlier developed by the authors for YBa_2Cu_3O , allowed to determine the electron spectrum parameters - conductive band width W , the band filling with electrons F and state localization degree - and also to observe their changing with x and y . The obtained results show that Ca is a supplier of charge carriers (holes) into the conductive band. It also has a stabilizing effect on the oxygen sublattice by preventing oxygen from leaving the sample during annealing. After Ca being introduced a certain balance between its content and oxygen deficit is established. This results in a constant value of F in the samples with different content of Ca, obtained under the identical heat treatment conditions. W , however, increases significantly with x , principally as a result of interval of the localized states increase. The obtained results analysis allowed to give a unified explanation of the change nature of $\rho(T)$ and $S(T)$ dependencies, of the band spectrum transformation and of the critical temperature dropping with x increasing.

MC-GP38. AN ANISOTROPY OF THERMOPHYSICAL PROPERTIES OF CRYORESISTIVE AL MAGNETIC SYSTEM, V. P. Dudko G. M. Zlobintsev, B. A. Merisov, V. N. Morgoon, V. P. Popov, Khar'kov State University, Khar'kov, Ukraine — Adhesive compounds based on epoxy adhesive and highpure Al ($r^{293}/r^{4,2} \sim 10000$) which are now in use to form the powerful cryoresistive magnetic systems (CMS) give evidence of an anisotropy of thermophysical properties which is difficult to estimate in a wide temperature range. The present paper deals with an experimental study of thermal resistance (w) and linear thermal expansion coefficient (LTEC) along and across the layers (in the 5—300 K range) of the magnetic system fragment which consists of 40 alternating Al layers. Thermal resistance measured across the layers was in considerable excess of that of the pure Al and the anisotropy value $w^{\wedge}/w^{\parallel}$ was found to be 1.9p

10^4 , $1.4p 10^4$ and $0.4p 10^4$ at 5 K, 20 K, and 40 K, respectively. The total thermal resistance of the sample measured across depends on the thermal resistances of adhesive and adhesive-Al boundary. Study of the LTEC of the magnetic system fragment has shown that an expected LTEC anisotropy should not be more than 5 % at room temperatures while increase in it can be observed at $T < 150$ K, for instance, the LTEC anisotropy will be over 300 % at 20 K. Thus, cooling the magnetic system fragment can cause ever greater reduction in its transverse sizes in comparison with the longitudinal ones, the original dimensions being equal at 293 K. When using the thermophysical coefficients to estimate the CMS performance the thermocycling effect on the LTEC value should be taken into account.

ICEC Session. Sensors (Thermometers, Squids) (EC-DP)

EC-DP1. THE PRIOR DIRECTIONS OF SUPERCONDUCTIVITY MICROWAVE ELECTRONICS, A. G. Denisov, Kiev, Ukraine, 254148, SPA "Saturn" — Some trends in the applied research can be distinguished already, whose advance is fundamental for developing a new class of radioelectronic devices, operating in millimeter and submillimeter electromagnetic wave bands. These include: 1. Development of matrix receiving systems of the radiovision. 2. Development of superconducting oscillators of the millimeter and submillimeter wave bands. 3. Development of Josephson effect-based devices for measurement and analysis of parameters of weak microwave signals. Research supported in part by the State Committee on Science and Technology under Contract No. 90103 and 90176.

EC-DP2. METHODOLOGY OF CALIBRATION OF RADIO FREQUENCY VOID FRACTION SENSORS, A. I. Alexeyev, Yu. P. Filippov, and I. S. Mamedov, Particle Physics Laboratory, Joint Institute for Nuclear Research, Dubna 141980, Moscow Region — The paper is devoted to the measurements of void fraction J of cryogens with radio frequency sensors whose readings w depend on dielectric permittivity of medium filling the sensor. The main problem, calibration, is discussed and a new approach to determination of $w(J)$ is developed. The method includes analysis of the sensor equivalent circuit which gives a set of possible calibration functions $w = w_i(J)$. Comparison with the measured parameters of the resonator allows to define the optimal function and its key coefficients. The feature is that the sensor readings are taken when the sensor is being filled with pure liquid and pure gas only. The applicability of function $w(J)$ obtained in this way over the whole two-phase range is shown. The experimental results for Methane, Nitrogen, Hydrogen, and Helium are presented. The obtained data demonstrate that the differences between the calibration functions for cryogens with low and high dielectric constants are rather considerable. The measurement error is estimated and its dependence on the type of cryogen is shown.

EC-DP3. THE LOW-TEMPERATURE DECIMETER WAVE IMPEDANCE OF ALUMINIUM MEASUREMENTS IN TRANSVERSE MAGNETIC FIELD, V. R. Sobol, A. A. Drozd, D. V. Pashik, Institute of Physics of Solids and Semiconductors, Byelorussian Academy of Sciences, Minsk, 220072 — The real part of low-temperature surface impedance of aluminium in magnetic field up to 7 T has been studied by the method of registration of the own Q-factor of coaxial shorted cylindrical resonator, being constructed entirely from the examined material. The wavelength of radio frequency (RF) field was equal to 70 cm. All measurements were made in a helium cryostat with superconducting magnet. The studied resonator was placed in a cylindrical

thermostat and oriented parallel to the magnetic field. The magnetic field dependence of the impedance was found to be different at the helium, hydrogen and nitrogen temperatures. So at $T = 4.2\text{--}30\text{ K}$ the impedance is nonmonotonic function of magnetic field and at higher temperatures the surface impedance has monotonic increase with magnetic field. This behaviour deals with the shorting side of resonator oriented perpendicular to the external magnetic field, because of the fact that on the cylindrical surfaces of the resonator the RF current is collinear to the magnetic field and isn't affected by it. At the low temperature and under the conditions of anomalous skin-effect the renormalising of the quantity of electrons is affected by both high and weak magnetic fields. At the higher temperature the skin-effect is close to normal and high frequency conductivity is monotonic function of the magnetic field.

EC-DP4. ALGORITHMS OF DATA PROCESSING FOR SPACE - DISTRIBUTED MULTICHANNEL SQUID-GRADIOMETER SYSTEMS FOR MAGNETIC SOURCE LOCALIZATION, *Gumeniuk-Sychevskij V., Nedayvoda I., Primin M., Institute of Cybernetics of Academy of Sciences of Ukraine, 252207, Kiev, Ukraine* — Algorithms of space analysis of magnetic fields, measured by known SQUID-gradiometers $\{B_z/L_k, \{B_z/L_k, B_z/L_k\}, L_k^2 B_z/L_k^2$ and others, in points of planar grid, are obtained and discussed. Magnetic inverse problem for dipolar layer or dipole, is analytically solved by integral double Fourier transformations method and/or eigenvectors method, correspondingly. Analysis of limitations, exposed on realization of these methods, allowed to optimize solution of magnetic inverse problem and correlation between source sizes, base of SQUID device, distance from source to SQUID device etc. Developed algorithms are used for data processing of experimental biomagnetic field distributions, obtained by 30-channel, planar, first-order SQUID gradiometers (Hoenig H., Daalmans G. et al., *Cryogenics*, 29, 809 (1989)). Results of biomagnetic source localization are agreed with results, obtained by application of other methods, and may be used, for example, in biomagnetic researches (MCG, MEG and others).

EC-DP5. RADIOTRANSAPRENCY OF GLASS-REINFORCED PLASTIC CRYOSTATS., *O. I. Lukatsky, Y. Y. Shapovalenko, Institute for Low Temperature Physics and Engineering of the Ukr. Acad. of Sci., Kharkov, 310164, Ukraine* — Experimental dependences of radiotransparency (P) of magnetotransparent cryostats made of glass-reinforced plastic material upon the design, structure and state of the insulation are described. The P value is shown to be influenced by the discrete electric conductivity of the multilayered insulation, thermal screens, isothermal character of the insulation, the number of layers and interrelated variations of different factors. Different ways of achieving the maximum P with respect to frequency are described and the P-dependence of the magnetic noises of the cryostat through the insulation is pointed out as the main source of noises above $\sim 10\text{ fT}/\text{H}^2$. The dependence is given of the thermophysical characteristics of various purpose cryostats upon the radiotransparency levels, complying with which is necessary for studies of space objects in a wide range of the electromagnetic radiation frequencies.

EC-DP6. A LASER-CONTROLLED SUPERCONDUCTING FLUX MODULATOR TO REDUCE SQUID NOISE, *S. I. Bondarenko, E. A. Golovanyev, V. V. Kravchenko, E. N. Tilchenko, L. D. Fesenko, V. V. Bakumenko, Inst. for Low Temp. Phys. & Engng, Ukrainian Acad. Sci., Kharkov, Ukraine* — It is known that a sensitivity of squid-based magnetometric devices is decreased in the low frequency range due to $1/f$ -noise in the squid (usually $f > 1\text{ Hz}$). It is possible to use the transformation of the squid-measured low frequency signal into the signal whose frequency exceeds the f_0 boundary of the $1/f$ noise to reduce the squid noise. For this purpose we developed a superconducting flux modulator in the squid input circuit operating at frequencies above f_0 . The modulator

is a laser-controlled heat switch. The modulator includes a niobium film (10-20 nm wide, 1 mm long, 60 nm thick) on glass, glass ceramic or sapphire substrate placed in liquid helium. A film portion is periodically transferred into a normal state by semiconductor laser pulses, applied through a light guide. The films becomes superconducting upon stopping the pulse action. Depending on the substrate heat conductivity the modulator resistance during the pulse action is within 3-700 Ω , and the maximum operating modulator frequency is between 0.5 and 500 kHz. The minimum laser radiation intensity necessary to operate the modulator is 1 mW. The modulator operation was studied in the squid-magnetometer.

EC-DP7. SINGLE FLUX QUANTUM VOLTAGE AMPLIFIERS, *V. M. Golomidov, V. K. Kaplunenko, M. I. Khabipov, V. P. Koshelets, O. V. Kaplunenko, Institute of Radio Engineering and Electronics, Russia Academy of Sciences* — The novel elements of the Rapid Single Flux Quantum (RSFQ) logic family - a Quasi Digital Voltage Parallel and Series Amplifiers (QDVA) have been computer simulated, designed and experimentally investigated. The Parallel QDVA consists of six stages and provides multiplication of the input voltage with factor six. Each of its stages contains only three Josephson junctions. The output resistance of this QDVA is six times larger than the input one so this amplifier seems to be a good matching stage between RSFQL and usual semiconductor electronics. The Series QDVA which provides gain factor four involves two doublers connected by transmission line series. This QDVA can be employed both as a logic element for digital circuits and as an analog voltage amplifier. Proposed Parallel QDVA can be integrated on the same chip with a SQUID sensor. It significantly simplifies the matching circuits and seems to be very attractive for the multichannel and digital SQUID systems. The integrated circuit is fabricated using 4m Nb-AlO_x-Nb trilayer technology with critical current density about 1000 A/cm².

EC-DP8. EXPERIMENTAL IMPLEMENTATION OF RSFQ SHIFT REGISTER, *V. K. Kaplunenko, D. Y. Khokhlov, V. P. Koshelets, S. A. Kovtonyuk, P. N. Shevchenko, Institute of Radio Engineering and Electronics Academy of Sciences* — Recently proposed RSFQ Shift Register (RSFQS) has been designed and experimentally investigated. Only two Josephson junctions are required for each bit of the DC powered RSFQSR, it is why the shift register seems to be very promising for creation compact cash memory. The test circuit consists of the two types of four bits registers. The first one is connected to the two SFQ generators and is designed to check high frequency operation of the RSFQSR by means of measuring of average dc voltages. The second one includes DC/SFQ and SFQ/DC converters as input and output interfaces and can be tested by traditional electronic equipment. The trilayer Nb-AlO_x-Nb technique is employed to fabricate externally shunted by Mo resistors tunnel junctions with critical current density 1000 A/cm².

EC-DP9. EXPERIMENTAL IMPLEMENTATION OF THE EIGHT BIT ANALOG-TO-DIGITAL CONVERTER, *V. K. Kaplunenko, M. I. Khabipov, V. P. Koshelets, S. A. Kovtonyuk, Institute of Radio Engineering and Electronics, Russia Academy of Sciences* — We realized and successfully tested recently two bit SFQ A/D converter. The new design and the improved technique of fabrication of tunnel junctions have allowed to expand the number of bits up to eight. This converter consists of a comparator and reversible ripple counter. The comparator is loaded with two SFQ transmission lines which are employed in respect to increasing or decreasing of the input signal. The pulses are transferred through these lines to the adding and diminishing inputs of the reversible counter. The counter involves transmission lines, splitters and confluence elements for sending diminish pulses directly to each bit. Non-destructive read-out of the counter contents carries out by SFQ/DC converters connected to each counter bit. The integrated circuit is fabricated using 4m Nb-AlO_x-Nb trilayer technology with critical current density about 1000