Session 23bE

Fabrication of Nb-based Superconducting Single Electron Transistor **23bE1**

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We have fabricated Nb/(Al-)AlO$_x$/Nb junctions with a single electron transistor (SET) geometry using conventional e-beam lithographic technique. It was possible to reach a clearly defined superconducting gap of 0.75meV as measured in the current vs voltage ($I-V$) characteristic curve, which corresponds to T_c of 4.6 K. The Josephson coupling energy $E_J = (h/4e^2)\cdot(\Delta_{Nb}/2R_n) \approx 32$ μeV was comparable to the charging energy $E_c \approx 35$ μeV which was determined from the $I-V$ curves as function of gate voltages. From the period of the gate modulated current we estimate the gate capacitance C_g to be 15 aF which coincides with that of Al/AlO$_x$/Al SET fabricated by us with the same geometry.

Mesoscopic effect observed in $YBa_2Cu_3O_{7-\delta}/La_{0.67}Sr_{0.33}MnO_3$ tunnel junctions **23bE2**

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The transport properties of YBCO/LSMO tunnel junctions have been studied at ultra-low temperature in order to clarify the influences of strong correlation on transport. The conductance spectra vary from usual BTK type to the phase coherent transport as the junction size becomes smaller. Conductance spectra obtained from small junctions show a periodic response to the applied magnetic field, which suggests the presence of the Aharanov-Bohm effect in the LSMO electrode.

23bE3 SQUID-detected NMR and MRI in Microtesla Magnetic Fields

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We have used a low-T_C SQUID to acquire nuclear magnetic resonance (NMR) spectra and magnetic resonance images (MRI) of room temperature samples in magnetic fields of a few microtesla, where the proton Larmor frequency is of the order of 100 Hz. The sensitivity of the SQUID magnetometer is independent of frequency. It is therefore possible to enhance both signal-to-noise ratio and resolution by detecting the NMR signal in microtesla fields, where the NMR lines become extremely narrow. We present spectra of heteronuclear coupled spin systems and MRIs of distilled water phantoms, and report on the progress of a SQUID-based system for *in vivo* MRI.

23bE4 Mobile High-Tc dc SQUID magnetometer

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By optimizing the designing, we made a smaller and low noise high-Tc dc SQUID readout electronics with the modulation freqency of 80 kHz. The white flux noise was about $30\mu\Phi_0/\sqrt{Hz}$ when Sumitomo dc SQUID sensor was used. We also proved mobile high-Tc dc SQUID magnetometer was feasible. By using a special compensation method, the SQUID magnetometer could keep locked when it swung about 20 degree in the earth field. This system can be used to detect the defects in ferromagnetic material or to be mounted in plane or boat for other applications.

23bE5 A Scanning SQUID Microscope in a Dilution Refrigerator

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We have designed and built a scanning SQUID microscope in a dilution refrigerator, capable of magnetic imaging at temperatures down to 20 mK. As sensors we use susceptometer SQUIDs with two pickup loops and on-chip field coils to allow measurement of both the magnetic susceptibility of the sample and the magnetic field at the sample surface on a mesoscopic lenth scale. The instrument is useful for studying superconductivity and magnetic effects in novel materials and electronic coherence effects (such as persistent currents) in mesoscopic systems.

A digital SQUID controller **23bE6**

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We describe the design, performance and limitation of an improved dc SQUID controller base upon a PC data acquisition board with a single digital signal processor (DSP). The main DSP algorithm that handles the flux-locked-loop, is optimally written in the DSP assembly language to minimize total execution time. The system is mostly built based upon commercially available instruments. To improve the performance of the controller, we have added a custom built frequency converter circuit that matches the modulation frequency of a commercial SQUID sensor and preamplifier. The noise level of the dc SQUID controller system is comparable with a commercial analog system, $\sim 4\mu\Phi_0/\sqrt{Hz}$ at 100Hz. The current system could control up to 5 SQUID channels.