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Superconductivity Coming to Market

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calibration are integrated. We will report on a new lithographic fabrication process, based on micromachining of a silicon-nitride membrane and various thin film deposition and etching steps, as well as the optimization of the transition edge thermometer. We will present characterization of voltage biased sensors in the 100 to 500 mK regime, read out by a SQUID, concentrating on responsivity, electrical noise equivalent power and time constants. The measurements are compared to calculated behaviour. * Supported by the Netherlands Foundation of Pure Research (NWO)

ENB-05

Niobium Josephson Junction Bolometers for Optical Detection in the VIS-IR region

Monticone, E Lacquaniti, V Steni, R Rajteri, M Rastello, M. L

The response of Nb Josephson junctions fabricated on different substrates, silicon and borosilicate, is measured under optical illumination at several conditions of light intensity and light chopping frequency. The linearity of the response on the optical power extends over five order of magnitude. The signal of the junction on silicon is 2 order of magnitude lower than a junction on borosilicate, but at least one order of magnitude faster, as the time constant of a directly irradiated junction on silicon is lower than 10 microsecond. The signal dependence on chopping frequency of the junction on silicon is quite constant, from 2 Hz to 1 MHz, while on borosilicate is typical of a strong thermal coupling between film and substrate. The response of two and three stacked junctions are also analysed. We observed an increment of the signal that depends on the number of the junctions of the stack. The thermal coupling between the junctions of the stack is analysed by changing the thickness of the intermediate layer between 15 nm and 100 nm.

ENB-06

Heat transport across N/d-wave superconductor interface

Devyatov, I.A Kupriyanov, M.Y Willander, M

Heat conductance and heat current across clean normal metal/d-wave superconductor interface are calculated in framework of quasiclassical equations. The calculations was performed for different values of boundary transparencies and crystal axis orientation. It is shown that in contrast to N/s-wave boundary the heat conductance of transparent (D=1) N/d-wave interface is considerably larger and has nonactivated form. We argue that this fact is a direct consequence of the possibility of effective heat flow in the directions of d-waves order parameter nodes. Heat current across N/d-wave superconductor interface is also calculated for different interface models taking into account the midgap states. The possibility of generating of gapless s-wave state in the vicinity of rough N/d-wave superconductor interface is also taking into account. The difference between the obtained results and the dependencies known for N/s-wave boundary are discussed. The possibility of using superconductor/normal metal interfaces for the purpose of microrefregeration are studied.

ENB-07

Thermal Boundary Resistance of a YBCO/STO Multilayer Strip.

Cheenne, N Hamet, J.F Rice, J.P Robbes, D

Our work is addressed to thermal resistance measurements at the boundary between a high Tc Yttrium-Barium-Copper-Oxide thin film and its substrate. We used a method based on the third harmonic generation of the voltage across YBCO strips heated by Joule effect above the film's Tc. At high frequency of the heating current, the deduced thermal resistance is dominated by the boundary effect. We used that method to evaluate the possible enhancement of the thermal decoupling between the upper layer (YBCO thicker film) and the MgO substrate when 10 bilayers YBCO/STO (2*8 nm thick) are deposited between them. The strips are 600μm long and 40μm wide. The thermal resistance has been measured at various frequency and temperatures above Tc, both for a monolayer reference sample and the multilayer sample. Using these results, we are currently calibrating the heating by an optical modulated laser diode against Joule heating above Tc. In turn the optical heating will allow the measurement of the thermal conductance at interface below the film's Tc, using the critical current variations as a very sensitive thermometer. Finally, we present the implications of our results in the field of antenna coupled micro-bolometer to operate in the very Far Infrared band.

ENB-08

Development of a Single-Photon, Imaging UV/Optical Spectrometer

Wilson, C.M Segall, K.J Li, L Prober, D.E Schiminovich, D Szymkowiak, A.E Moseley, S.H

We are developing a single-photon, imaging UV/optical spectrometer using superconducting tunnel junctions. The work is an extension of an ongoing project developing x-ray spectrometers. Incident photons are absorbed in a superconducting Ta film, breaking pairs and creating excess quasiparticles. The quasiparticles diffuse and are read out by Al tunnel junctions on either end of the absorber. The total charge created is proportional to the energy of the photon. We extract imaging information from the way charge divides between the two junctions. Superconducting detectors have a gap a thousand times smaller than a typical semiconductor detector (about 1 meV compared to 1 eV). This allows for superior energy resolution and detection of lower energy photons. We will discuss detector design and operation and show preliminary detector results. Potential applications include UV/optical astronomy and biological imaging.

ENB-10

Nb/Al-AlOx/Nb Edge Junctions for Distributed Mixers*

Amos, R.S Lichtenberger, A.W Tong, C.E Pan, S.K

We have fabricated high quality Nb/Al-oxide/Al/Nb edge junctions using a Nb/Si-dioxide bi-layer film as the base electrode, suitable for use as traveling wave mixers. An edge is cut in the bi-layer with an ion gun at a 45 degree angle using a photoresist mask. The wafer is then cleaned in-situ with a physical ion beam followed by the deposition of a thin Al (a1) film, which is then oxidized, an optional second Al (a2) layer, and a Nb counter electrode. It was found that devices with an a2 layer resulted in superior electrical characteristics, though proximity effects increased strongly with a2 thickness. The counter electrode is defined with an RIE etch, using the Al barrier layer as an etch stop. The Al layer is then either removed with an Al wet etch to isolate the individual devices or the devices are isolated with an anodization process. The electrical quality for the wet etch isolation technique were consistently lower in quality, though for junction widths on the order of 1 micron or smaller, the process can degrade the electrical characteristics due to lateral encroachment of the anodization field. Various ion gun cleaning conditions were examined, also both wet and plasma etch bi-layer edge surface pre-treatments were investigated. It was found that edge junctions with large widths (those more suitable for traveling wave mixers) typically benefitted more from such treatments. Initial receiver results at 230 Ghz have yielded a DSB noise temperature of 50K. * supported by NSF grant AST-9618747 and NASA grant NAG5-6084 ** presently at IBM Burlington Vt

ENB-11

Optoelectronic Parameters of High-temperature Superconductors

Netesova, N.P Yakunin, V.G

Earlier the electron anharmonic oscillator model for high-temperature superconductor was proposed [1]. In development of these ideas the polyoscillator curves of real and imaginary components of dielectric