LOW-NOISE, WIDE BANDWIDTH, HOT ELECTRON BOLOMETER MIXERS FOR SUBMILLIMETER WAVELENGTHS

W.R. McGrath[1], A. Skalare[1], B. Karasik[1], B. Bumble[1], H.G. LeDuc[1], P.J. Burke[2], R. Schoelkopf[2], D.E. Prober[2]

[1]Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109

[2]Dept. of Applied Physics, Yale University, New Haven, CT 06520-8284

Recently a novel superconductive hot-electron micro-bolometer has been proposed which is both fast and sensitive (D.E. Prober, Appl. Phys. Lett. 62, 2119, 1993). This device has several important properties which make it useful as a heterodyne sensor for radioastronomy applications at frequencies above 1 THz. The thermal response time of the device is fast enough, several 10's of picosecond, to allow for IF's of several GHz. This bolometer mixer should operate well up to at least 10 THz. There is no energy gap limitation as in an S1S mixer, since the mixing process relies on heating of the electron gas. In fact, *rf* power is absorbed more uniformly above the gap frequency. The mixer noise should be near quantum-limited, and the local oscillator (LO) power requirement is very low: ≈ 10 nW for a Nb device. One of the unique features of this device is that it employs rapid electron diffusion into a normal metal, rather than phonon emission, as the thermal conductance that cools the heated electrons. In order for diffuion to dominate over phonon emission, the device must be short, less than 0.5 µm.

We have measured the heterodyne performance of a submicron Nb bolometer mixer at 530 GHz in a waveguide receiver, originally designed for observation of H_20 in the interstellar medium (A. Skalare, W. McGrath, B. Bumble, H. LeDuc, P. Burke, A. Verheijen, D. Prober, IEEE Trans. Appl. Superconductvity S_, 2236, 1995). The double sideband (DSB) receiver noise temperaure is 650 K with an *IF* of 1.4 GHz. The 3 dB *IF* rolloff frequency is measured at 1.7 GHz, and the estimated LO power is 10-20 nW. This represents the widest bandwidth achieved in a low noise bolometer mixer for submillimeter wavelengths. The LO frequency of 530 GHz is above the gap frequency of ≈400 GHz for the Nb film used in this device (the film thickness is ≈10 nm, which leads to a "dirty" film with reduced $T_c \approx 5.5$ K. The "dirty limit" is required for enhanced electron-electron interactions which leads to a hot electron gas when *rf* power is absorbed). An important properly of these devices is the predicted frequency independence of the heterodyne performance. To test this prediction, we are reconfiguring our receivers to measure the noise temperature, bandwidth, and LO power at 1200 GHz and 2500 GHz. Results will be discussed.

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