SUPERCONDUCTING HOT ELECTRON BOLOMETER MIXERS FOR SUBMILLIMETER RECEIVERS

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In recent years, S1S (Superconductor-Insulator-Superconductor) devices have been established as the most sensitive mixing components for heterodyne receivers at millimeter and submillimeter wavelengths, There is some concern, however, with the degradation in noise performance such devices are expected to show above their superconducting gap frequency. An alternate route to frequencies above 1 THz maybe the superconducting hot-electron bolometer mixer, which should not experience the same high frequency limitations as the S1S mixer. The intermediate frequency of such a mixer is limited by the finite time required to cool the hot electrons. One mechanism for this can be electron-phonon interaction [1,2]. We are currentl y investigating another option, where the bolometer is a very short (≤ 0.5 μm) niobium microbridge[3]. The short length allows rapid diffusion of the hot electrons into the contacting normal metal gold films. This thermal conductance can dominate by a factor > 10 over the electron-phonon interaction. This leads to predicted intermediate frequencies as high as 4 GHz.

We are presently evaluating the performance of small (O. 1 μm x 0.5 μm) microbridges as submillimeter mixers. An existing 547 GHz S1S receiver[4] has been adapted to meet the thermal requirements of hot electron bolometers, and the measured performance will be presented at the conference.

We have also determined the electron-bath thermal conductance in larger niobium microbridges (1 μm x 10 pm). This was done by measuring the shift in the resistance-versus-temperature curve, while dissipating a known amount of DC power in the bridge. For microbridges of this length, the dominant cooling mechanism is expected to be electron-phonon interactions. We find approximate agreement with previously reported measurements of the electron-phonon thermal conductance[1,2].

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