Tantalum Hot-Electron Bolometers for Heterodyne Receivers

Anders Skalare, William R. McGrath, Bruce Bumble, Henry G. LeDuc
JPL

In recent years superconducting HEB mixers have been applied to high-resolution spectroscopy at frequencies exceeding 1 THz, with instruments being built for platforms such as *Herschel* and *SOFIA*. In theory, bolometers with lower transition temperatures (Tc) than the Nb and NbN devices that are used today should yield lower mixer input noise and reduced requirements on local oscillator power. We are therefore investigating a different material, tantalum, which can have Tc's of about 3 K (in thin films), and can have sufficiently low film resistance (and therefore high heat conductance) that it should rival Nb with regard to intermediate frequency bandwidth. Submicron-size devices (length = 0.4 micron, width=0.2 micron) that have been fabricated for this study have resistances of 36 ohms/square, a supercurrent of up to 40 microA (at 0.4 K), and a transition temperature of 2.3 K with a narrow transition width of about 0.2 K. A He3 test receiver has been equipped to measure mixer performance both at microwave frequencies (1 to 18 GHz) and submillimeter wavelengths down to an ambient temperature of 0.4 K, and the most recent rf results of bandwidth and noise will be presented at the workshop. This work was supported by NASA.