Diffusion-Cooled Tantalum Bolometers for Heterodyne Mixers

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Superconducting hot-electron bolometers (HEB's) made from Nb and NbN are used in receivers for high-resolution spectroscopy above 1 THz. Instruments are planned for the *Herschel Space Observatory* and NASA's *SOFIA* airborne observatory. The input mixer noise of HEBs should in principle scale with the transition temperature (Tc) of the superconductor. We are conducting a study of a lower-Tc material, Tantalum, in order to both improve the noise performance and lower the local oscillator power needs compared to existing Nb and NbN devices. Tantalum devices can have film resistances similar to Nb, which should lead to significant heat conductance and high intermediate frequency bandwidth. We have fabricated submicron-size (length = 0.4 micron, width = 0.2 micron) Ta devices with a film resistance of 36 ohms/square, and with Tc up to 2.3 K with a transition width of 0.2 K. The devices are diffusion-cooled bolometers rather than weak links, since the output noise at high DC bias is proportional to the bias current, and no Shapiro steps appear when microwave power at 1 to 18 GHz is applied. Mixer experiments at 1 to 18 GHz and at millimeter wavelengths are currently underway to determine the thermal time constant of the devices and the noise properties. The presentation will include latest results from these measurements.

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