Submillimeter heterodyne detection using diffusion cooled superconducting hot-electron bolometers

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Bolometers have been used in the past as heterodyne mixers primarily because of their high sensitivity and their ability to operate at very high frequencies. However, the very slow thermal response time limits the intermediate frequency to a range too low to be of practical value, and so bolometer mixers have not found widespread use. Recently a new type of bolometer mixer has been proposed with thermal response times of practical value (~40 ps). It consists of a Nb microbridge and uses electron out-diffusion as a cooling mechanism. We have fabricated and tested this diffusion-cooled hot-electron bolometer mixer at 530 GHz and obtained a receiver noise temperature of 650 K DSB, a mixer noise of 560 K, and a conversion efficiency of -11.5 dB. The measured 1 t: roll-off frequency is close to 2.5 GHz, which is the highest ever achieved with a sensitive bolometer mixer. The thermal response time is 55 ps, which is several orders of magnitude faster than conventional thin-film or bulk bolometers. This bolometer mixer is expected to operate well up to several THz. Preliminary design considerations and results will also be discussed for operation at 1200 GHz.