Experimental Study of SubMM Wave Superconducting Hot-Electron Direct Detectors

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We are developing a new type of hot-electron direct detector (HEDD) which employs a weak electron-phonon coupling in superconducting microbridges. Such a detector with a potential NEP of 10^{-20} W/Hz$^{0.5}$ will meet the needs for future background-limited arrays on space telescopes. The HEDD is based on a 1-micron-size transition edge sensor fabricated from an ultra-thin film of a superconductor with T_c = 0.1-0.3 K. The strong temperature dependence of the electron-phonon coupling in impure superconductors allows for adjustment of the electron-phonon scattering time to the desirable value of ~ 1 ms. We have measured such a time constant at T = 0.1 K for films fabricated on thick substrates; thus having shown that a micromachined, high-thermal-resistance suspension of the detector is not needed. The radiation frequency response of prototype antenna-coupled Nb devices has been found to be flat over the range 250-1000 GHz. The results on fabrication, characterization and noise measurements in HEDD devices made from Ti with higher T_c superconducting Andreev contacts will be also presented. Also, first test results of a multiplexing scheme based on an encoding technique using Hadamard Transforms will be discussed. This technique should allow for reading out a large number of bolometers (~10^4) with a single SQUID amplifier thus enabling a compact monolithic submillimeter wave camera on a chip for astrophysical imaging applications.