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Ultra-Sensitive Hot-Electron Detectors of IR/sub-mm Radiation
WEI JIAN, DAVID OLAYA, SERGEY PEREVERZEV, MICHAEL GERSHENSON, Rutgers University, BORIS KARASIK, JPL, Caltech, ANDREW SERGEEV, SUNY at Buffalo — We have developed a superconducting nanostructure that enables an ultra-sensitive detection of far infrared (FIR) and sub-mm radiation. The nanostructure consists of a Ti nanobridge with a volume of $\sim 3\times 10^{-3}$ μm^3 flanked with Nb current leads. The electrons in the nanostructure are thermally isolated from the heat bath due to Andreev reflection from superconducting Nb leads and a weak electron-phonon coupling at mK temperatures. Being driven into the resistive state by the temperature and/or magnetic field, this transition-edge sensor is very sensitive to electron overheating. According to our measurements of the thermal conductance between the electrons in the nanobridge and the heat bath, the expected noise equivalent power and the response time of the detector at T=0.1 K are $\sim 10^{-20}$ W/Hz$^{1/2}$ and $\sim$1 ms, respectively. Alternatively, this nanostructure with a heat capacity C $\sim 10^{-19}$J/K at T=0.1 K can be used for the calorimetry of photons and phonons with an energy resolution $\sim 10^{-21}$ J. This resolution is sufficiently high for the detector to operate in a regime of THz photon counting.

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