Hot-Electron Superconducting Detectors for High-Background Sub-mm Wave Applications

Boris Karasik (Jet Propulsion Laboratory)
Andrew Sergeev (Wayne State University)

We will discuss a choice of material and optimization of material parameters (disorder-controlled electron-phonon coupling) in order to achieve a particular combination of speed and sensitivity in hot-electron superconducting detectors required by application. Hot-electron detectors (both resistive and kinetic inductive) are under development for submillimeter astronomical missions. One of the strong advantages of these detectors is a possibility of fabricating large planar-antenna-coupled arrays of detectors on a Si wafer. For high background applications, different superconducting materials should be used. Fortunately, there is a large selection of thin film superconducting materials (Ta, Nb, NbN, NbTiN) with relatively high critical temperature from 3 K to 10 K that can be interesting for Earth science and planetary science detector applications. By manipulating the operating temperature and the degree of material disorder, one can vary the response time in the detector by many orders of magnitude. Another way to control the speed is to use a hot-electron sensor in the diffusion-cooled mode. Here the effective response time can be as short as 20 ps. An analysis of the expected performance of hot-electron sensors (NEP, speed, dynamic range) in the Sub-mm/Far IR for different background radiation levels will be presented.

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.