Resistive Behaviorsof a superconducting NbN hot electron bolometer in a magnetic field

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We report on the detailed study of resistive behaviors of an NbN superconducting hot electron bolometer (HEB) in a perpendicular magnetic field. The superconducting HEB device consists of an NbN thin-film microbridge measuring 0.2-mm long, 2.0-mm wide and 5.5-nm thick and a twin slot antenna for coupling THz radiation. We have measured the resistance-temperature and current-voltage characteristics of the superconducting HEB device by changing the applied magnetic fields. It is clearly observed that the external magnetic field enhances the thermally activated flux flow leading to the broadening of the resistance-temperature transition. The external magnetic field also enhances the density of free vortices and the flux flow resistance is therefore increased significantly. From the measured current-voltage characteristics of the superconducting HEB device, we find that the flux flow resistance is nearly linearly proportional to the magnetic field at low vortex velocities. At high vortex velocities, instability appears in the measured current-voltage characteristics of the superconducting HEB device. We attribute this instability to the nonlinear flux-flow behavior according to the Larkin and Ovchinnikov theory. In terms of the dependence of the instability upon the applied magnetic field, we have extracted the inelastic scattering time and the diffusion length of quasiparticles. The magnetic field dependency of the direct detection characteristics of the superconducting NbN HEB at 4 K has also been studied. Detailed experimental results and analysis will be presented.