超伝導ミクサ素子の設計ための数値シミュレーションコードの開発

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Development of Numerical Simulation Code for THz-Band Superconducting Hot-Electron Bolometer Mixer Designing

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THz region is an unexplored frequency band in heterodyne sensing technology fields, because a conventional SIS mixer does not work due to superconducting Cooper pair breakdown by photon absorption in the THz band. To overcome this obstacle, an alternative THz-band heterodyne device known as a hot-electron bolometer (HEB) mixer is studied, and successful laboratory experiments have already been reported. However, physical mechanisms of the HEB mixer device are not yet sufficiently understood. Thus we develop a new numerical simulation code to understand physical processes in the HEB mixer device, which aims to improve the fabrication process for superconducting HEB mixer microbridges. Since the microbridge consists of a coplanar line structure, we numerically model the coplanar line by using the FDTD (Finite-Difference-Time-Domain) method. We also introduced superconductors into the FDTD code by solving the London equation. In the present study, we use an empirical model of superconductivity as a function of temperature. We found that the mixing of the radio signal and the reference signal occurs when the superconductivity changing in time at the frequency of these signals. We are now introducing heating and cooling of superconductor by solving the thermal diffusion equation.