

NOISE TEMPERATURE OF NbN HOT-ELECTRON QUASIOPTICAL SUPERCONDUCTING MIXER IN 200–700 GHz RANGE

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The electron heating effect in superconducting films is becoming very attractive for the development of THz range mixers because of the absence of frequency limitations inherent in the bolometric mechanism. However, the evidence for the spectral dependence of the position of optimal operating point has been found recently for NbN thin film devices^{1,2}. The effect is presumably attributed to the variation in the absorption of radiation depending on the frequency. Since the resistive state is not spatially uniform the coupling efficiency of the mixer device with radiation can be different for frequencies larger than $2\Delta/h$ and those smaller than $2\Delta/h$ (Δ is the effective superconducting gap in the resistive state). To study the effect more thoroughly we have investigated the noise temperature of quasioptical NbN mixer device with broken-line tapered slot antenna in the frequency range 200–700 GHz.

The device consists of several (5–10) parallel strips 1 μm wide and 6–7 nm thick made from NbN film on $\text{SiO}_2\text{-Si}_3\text{N}_4\text{-Si}$ membrane. The strips are connected with the gold contacts of the slot-line antenna which serves both as bias and IF leads. We used backward wave oscillators as LO sources and a standard hot/cold load technique for noise temperature measurements.

The frequency dependence of noise temperature is mainly determined by two factors: frequency properties of the antenna and frequency dependence of the NbN film impedance. To separate both factors we monitored the frequency dependence of the device responsivity in the detector mode at a higher temperature within the superconducting transition where the impedance of NbN film is close to its normal resistance. In this case the impedance of the device itself is frequency independent. The experimental results will be reported at the Symposium.

1. G. Gol'tsman, S. Jacobsson, H. Ekström, B. Karasik, E. Kollberg, and E. Gershenzon, "Slot-line tapered antenna with NbN hot electron mixer for 300–360 GHz operation," *Proc. of the 5th Int. Symp. on Space Terahertz Technology*, pp. 209-213a, May 10-12, 1994.
2. B.S. Karasik, G.N. Gol'tsman, B.M. Voronov, S.I. Svechnikov, E.M. Gershenzon, H. Ekström, S. Jacobsson, E. Kollberg, and K.S. Yngvesson, "Hot electron quasioptical NbN superconducting mixer," presented at the ASC'94, submitted to *IEEE Trans. on Appl. Superconductivity*.