

Single Junction Design for 790-950GHz SIS Receiver

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Two years ago, we have fabricated and tested superconductor-insulator-superconductor (SIS) mixers based on Nb/AlN/NbN twin tunnel junctions for waveguide receiver operating in frequency range of 790 - 950 GHz, which demonstrated noise temperature from 250 K at low frequencies to 500 K at the high end of the band. Due to high current density of the junctions (up to 30 kA/cm²), a wideband design was realized.

Based on result for twin junction, a new mixer design with single SIS junction was proposed and produced. The single junction design is expected to have narrower frequency range than twin-based one, but still wide enough, and provide better coupling in the middle of the band. In addition, the critical current suppression will be much better, than for twin junction, which has an intrinsic problem of difference between areas of individual junctions. The SIS junction in new design is made by Nb/AlN/NbN technology and incorporated in a microstrip line consisting of a 300 nm thick bottom electrode (ground plane) made of NbTiN and a 500 nm thick top electrode made of Al. The top Al electrode is passivated by the SiO₂ layer for protection. The DC tests of the fabricated wafer shows, that optimization of the technology allowed to realize gap voltage of 3.2 mV even for junctions of 0.5 square micron area fabricated on the NbTiN bottom layer. The FTS and noise temperature measurement of new mixers will be done in the nearest future and will be presented in comparison with the twin junction design results at the conference.