Intrinsic Mixing Behavior of Superconducting NbTiN HEB Mixer Based on in-situ Technique

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***Abstract*—In this paper, we present the intrinsic mixing behavior of superconducting niobium titanium nitride hot electron bolometer mixer based on in-situ technique. We make detailed comparison between simulated and measured performance of the HEB mixers at 0.8 and 1.5 THz. A distributed hot spot model which is based on solving a heat balance equation is employed to characterize current-voltage curve, electron and phonon temperature distribution along superconducting microbridge, intermediate frequency gain bandwidth and intrinsic noise temperature of the mixers. The simulated intermediate frequency gain bandwidth decreases with the increase of microbridge length, which is in good agreement with measured results. For the microbridge with 0.15 μm in length, the IF gain bandwidth is simulated to be 2.6 GHz at 0.8 and 1.5 THz. When the microbridge length is increased to 0.3 μm, the calculated IF gain bandwidth is 1.8 GHz. The simulated results demonstrate the IF gain bandwidth is only related with microbridge length, independent of RF frequency.**

It's very useful to find the critical parameters which mainly affects the mixer noise temperature and IF gain bandwidth. In this paper we will give the critical factors as the reference for fabrication and measurement of HEB mixers. We have found that when the ratio of length to width of the microbridge is set to be around 0.15, the simulated and measured mixer noise temperature show the lowest value. More details will be presented in the paper.