The Development of an 850 GHz Waveguide Receiver using Tuned SIS Junctions on 1μm Si_3N_4 Membranes.

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ABSTRACT

We report preliminary development work on a 850 GHz SIS heterodyne receiver employing a tuned niobium tunnel junction on a 1 μm Si_3N_4 supporting membrane. Since the mixer is meant to be operated well above the superconducting gap frequency of niobium ($2\Delta/h \approx 690$ GHz) special care has been taken to minimize transmission line loss. We have therefore used junctions with an integrated radial stub RF matching network to tune out the large shunt susceptance of the junction and minimize the niobium film absorption loss. Scale model measurements of the waveguide embedding impedance have been made to aid in the design of the choke structure and RF matching network. Detailed Fourier Transform Spectrometer measurements of tuned junctions on both SiO_2 and silicon nitride membranes show response up to 1100 GHz and indicate that the absorption loss in the niobium film is in the order of 4-7 dB at 850 GHz, in fairly good agreement with the theoretical loss calculated from the Mattis-Bardeen theory. The junctions have a center frequency of 800 GHz which presents a 6% downshift from the designed value.