A SUPRATHz SIS HETERODYNE RECEIVER USING WAVEGUIDE / MEMBRANE TECHNOLOGY.

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ABSTRACT

Among the top priority scientific goals of ESA's FIRST mission is the heterodyne detection of interstellar water via its information-rich submm transitions above 1 THz. While 'classical' SIS receivers using the now well-mastered niobium technology will fail to match this goal, cautiously designed SIS receivers with good-quality NbN junctions offer a potential solution.

As part of a european research and technology effort led by ESA, an heterodyne receiver based on waveguide/membrane technology has been developped for use in the range 1.2 -1.6 THz, using ~1-μm^2 NbN/AlN/NbN and NbN/MgO/NbN high current density SIS tunnel junctions. The process to fabricate these junctions on thin (~1-μm) SIMOX membranes is described, and DC characteristics of the junctions are presented.

Al/SiO_2/Al microstrip circuits are used to tune the junctions and to match a waveguide-to-suspended-microstrip transition over a broad bandwidth, in association with a dumbell non-contacting backshort. The 1.5-mm square membrane is wet-etched in the silicon chip which supports both the IF and DC circuits and is reliably suspended 5-7 μm away from the injection and backshort sections of waveguide. A novel design for the mixer block allows to reach (with relatively low cost) an accuracy better than 1 μm on the waveguide dimensions and the ground to strip spacings. To carry out acurate receiver noise measurements above 1 THz, an automated calibration apparatus was constructed and a CO_2-pumped FIR laser is used as an LO.

In this paper, DC characteristics of the NbN junctions and preliminary results from RF measurements are presented and discussed.

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