Fabrication of Nb / AL-N_x / NbTiN Junctions for SIS Mixer Applications

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ABSTRACT

Processing techniques are discussed for fabrication of superconductor-insulator-superconductor (SIS) junctions which typically exhibit 3.5 mV sum-gap voltage. Junctions can have sub-gap to normal state resistance ratio Rsg / R_N = 25 for resistance - area products R_NA = 20 Ω μm^2 and high quality junctions have been produced with RnA products down to 4 Ω μm^2 . Results for all Nb junctions with high current density aluminum-nitride barriers are also shown. The focus of this work is a device structure which has Nb as a base layer, a tunnel barrier formed by plasma nitridation of a thin Al proximity layer, and NbTiN as a counter-electrode material. Nitridation of the aluminum layer is investigated by control of the DC floating potential on a separate RF driven electrode in the vacuum process chamber. Devices are integrated to mixer antenna structures incorporating NbTiN as a ground plane. The wire circuit layer can be either normal metal or NbTiN. Annealing results show improved I-V characteristics with slightly increased RnA products. Recent receiver results employing these junctions exhibit low noise performance up to 850 GHz. [1]

J.W. Kooi, J.A. Stern, G. Chattadpadhyay, H.G. LeDuc , B. Bumble, and J. Zmuidzinas, "Low-loss NbTiN films for THz SIS mixer tuning circuits," Int. J. IR and MM Waves **19**, 1998