Development of 1.4THz Hot Electron Bolometers

Ming-Jye Wang[1], Hsian-Hong Chang[1], Wen Zhang[2], Wei Miao[2], Sheng-Cai Shi[2]

1. *Institute of Astronomy and Astrophysics, Academia Sinica, Taiwan*
2. *Purple Mountain Observatory, Nanjing, China*

Nowadays, hot electron bolometer (HEB) is the most convincing devices on detecting THz signal. Noise temperatures of HEBs with near 10 times of quantum limit noise level have been demonstrated at frequency up to several THz. Therefore, HEBs are potentially to be used in Dome A 5-meter Telescopes and Greenland Telescopes which are two of the best sites for THz astronomical telescopes.

The HEB devices are designed for the 1.4 THz window of atmosphere by using superconducting NbTiN mirco-bridge on silicon substrate with twin-slot antenna. The length and width of slots and the separation of slot antenna are $L=0.285\lambda_0$, $W=0.0234\lambda_0$, and $S=0.164\ \lambda_0$ respectively, where λ_0 is 214 μm at 1.4 THz. The signal is transferred between slot antenna and NbTiN superconducting micro-bridge by a co-planar waveguide (CPW) with characteristic impedance of 37 Ω. The size of NbTiN superconducting bridge is 2 μm(W) by 0.3 μm(L) and its normal state resistance is targeting to 60 Ω to match the impedance of feed-point from CPW.

The thin superconducting NbTiN films are deposited using Ar and N_2 mixture by a DC sputtering system. The superconducting transition temperature and sheet resistance of 8 nm thick film is around 11 K and 330 Ω/square. The micro-bridges are patterned by E-bean lithography technique and reactive ion etching process. The temperature dependence of resistance of HEB device typically shows two superconducting transitions at 11 K and 8.5 K, which is from micro-bridge and contact pad respectively. The critical currents of devices have a value around 200 μA. More device's parameters and performance will be presented in this paper.