Follow-up experiments of the gain and noise IF bandwidth for a Ni-NbN HEBM

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We are developing an HEBM at 2 THz for atmospheric research to measure emission line spectrum of OH at 1.83 THz and O-atom at 2.06 THz from space. We have reported widening of the gain IF bandwidth of the HEBM using a newly proposed HEBM device which uses a magnetic thin film to suppress the superconductivity under the electrode which is called a Ni-NbN HEBM [1, 2]. The gain IF bandwidth was measured to be ~6.9 GHz. The gain IF bandwidth was measured by measuring a signal to noise ratio (SNR) of the beat note of the THz signal generated by an amplifier/multiplier chain (AMC) source with a fixed frequency and an output power. To measure the SNR of the beat note, the LO (AMC source) frequency was changed to change the beat note frequency. When the LO frequency is changed, the LO power is also changed which affects the operating conditions of the mixer, therefore, the LO power was adjusted to keep to the bias current of the mixer same at each LO frequency.

In this experiments, however, we did not much care about the saturation problem of the received signal. That is, if the input THz power is too much, the IF output of the HEBM will saturate and lead to incorrect results. The IF bandwidth was measured for the input THz power without attenuation of the input power (i.e., full power of ~9 μW) and for the 15 % of the power. The result shows that for the full power input, the IF response was almost flat with the SNR of ~53 dB until around 8 GHz. For the 15 % of the power input, the IF level gradually decreased and result shows a reliable bandwidth. From this experiment, we can conclude that our previously measured gain IF bandwidth was not affected by such a saturation effect.

To confirm the measured result of the IF bandwidth, we have also measured the noise IF bandwidth for the normal NbN and the Ni-NbN HEBM. The receiver noise temperature was measured by the conventional Y-factor method using a LNA and a room temperature amplifier with a frequency range of 1-12 GHz. A cryogenic amplifier/multiplier chain (AMC) source at 1.94 THz was used as a local oscillator (LO). The two triplers of the AMC source were cooled to 50 K using a mechanical cooler [3]. Although we need more confirmation experiments, the result (Fig. 1) shows the wider noise IF bandwidth for the Ni-NbN HEBM of ~7 GHz than that for the NbN HEBM of ~4.7 GHz. The measured noise IF bandwidth is almost the same as the gain IF bandwidth.

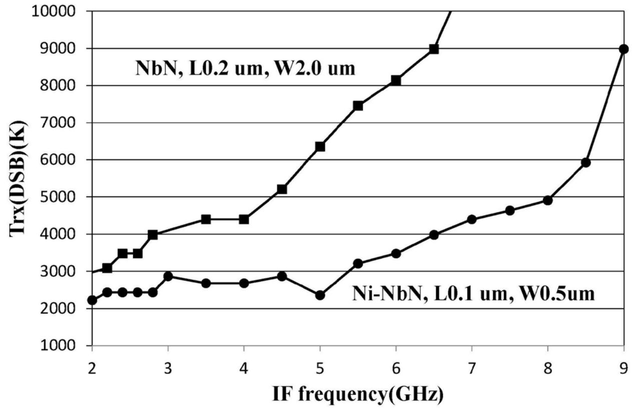

Fig. 1. Measured noise IF bandwidth of the NbN and the Ni-NbN HEBM at a LO frequency of 1.94 THz. The Ni-NbN HEBM shows the wider bandwidth of ~7 GHz.

REFERENCES

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