Analysis of Gunn Diode Oscillator in Frequency Domain at Millimeter-wave Frequencies

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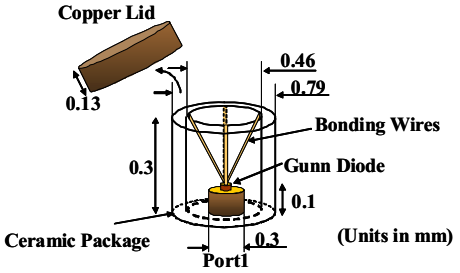
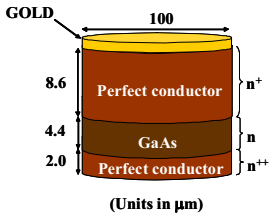
Gunn diode is a promising candidate for a millimeter-wave source because of high oscillation power as well as direct oscillation. Actually, it is applied in many systems such as marine radars, Doppler radars, surveillance radars and so forth. Such Gunn oscillators were mostly designed by experimental procedure or by theoretical model based on equivalent networks. To improve the accuracy of the design method, the Gunn device was exactly modeled and an oscillation frequency was calculated by using electromagnetic simulator (HFSS) in this paper. Figure 1 (a) shows the Gunn device, which is sealed in an alumina cylinder. The Gunn device was put on a cathode made by a metal disk, being placed on the bottom plane of the alumina cylinder. As an anode, a copper lid was put on the upper plane of the alumina cylinder though cross-shaped bonding wires. Figure 1 (b) shows the analytical model of the Gunn device. An active layer of the n-GaAs with a thickness of 4.4 μm, was sandwiched by n+ and n++ layers. In calculation, the n+ and n++ layers were assumed to be conductors and the whole structure was decided to be a circular shape with a diameter of 100 μm. Assuming the input port at the bottom plane of the alumina cylinder as shown in Fig. 1 (a), the input impedance was calculated by using the HFSS, and the oscillation condition was applied. By employing this technique into the NRD guide Gunn oscillator, the oscillation frequency was calculated as shown in Fig. 2 as a red curve. The measured result is also depicted as circles. Agreement between the calculation and measurement is quite satisfactory, and thus the validity of this theory is confirmed.



(a) Diode in ceramic package.



(b) Detailed view of diode

Fig. 1 Analytical model of Gunn diode.

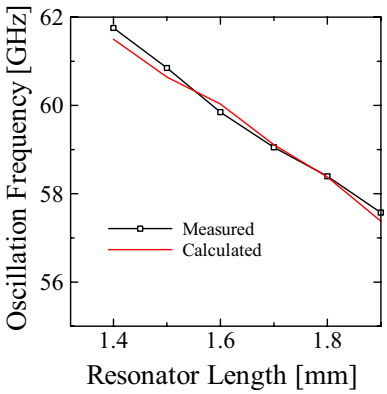


Fig. 2 Calculated and measured oscillation frequencies.