

Self-Injection Locked NRD Guide Gunn Oscillators Using Metal Rod Resonator at 60 GHz

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In conventional self-injection locked NRD guide Gunn oscillators, ceramic resonators with an unloaded Q-factor of about 4000 were used as external resonators for the self-injection locking technique. Another candidate for external resonators is a metal rod resonator which is set at the horizontal mid-plane in parallel metal plates and had an unloaded Q-factor of about 1300 in our preliminary measurement. The metal rod resonator could be desirable for the self-injection locking from the viewpoint of cost-effectiveness and fabrication accuracy as an operational frequency becomes higher, but there is still a concern about the low unloaded Q-factor compared with that of the ceramic resonator.

In this paper, the feasibility of the self-injection locking using the metal rod resonator was confirmed through theoretical calculation by an electromagnetic simulator.

At first, the cutoff frequency of the first higher mode of the metal rod resonator was calculated because there are two types of the self-injection locking techniques, the reflection and band-stop types, in which the first higher mode and the TEM mode are used. Next, the diameter and length of the metal rod resonator were optimized so that the resonator has the highest unloaded Q-factor in each mode. After that, calculation models of the two types of the self-injection locked NRD guide Gunn oscillators using the metal rod resonators were made and the oscillation characteristics were calculated. From the results, it was confirmed that the oscillation performance was almost the same as that of the oscillator using the ceramic resonator.

The next step of this research is to verify the calculated consideration by experiments.