Development of high-power rectennas with GaN schottky diode

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As a new application of wireless power transmission technology, a wireless power distribution system for buildings is proposed. This system supplies electric power wirelessly by transmitting microwave through building materials or deck plates which are used as microwave transmission waveguides.

First, the necessity of a rectifier circuit that converts microwave power into DC power is described. The size of the rectifier circuit is necessary to be smaller than 10cm3. Then, development of the rectifier circuit with GaN schottky diode is required for high-power rectification, because its breakdown voltage is much higher than that of Si schottky diode.

Next, rectifier circuits were designed with computer simulation. GaN diodes were connected in parallel, and the number of diodes was changed from 1 to 8. From simulation results, the efficiency was increased, when the number of diodes was increased. This is because the impedance was decreased, and power loss of diodes was reduced as the diodes was connected in parallel. Then, rectifier circuits with GaN schottky diode whose breakdown voltage is 40V were designed and experimentally produced. However, all of the developed rectifier circuits were low efficiency. This is because the influence of gold wire was wrong, or SPICE parameter was different from real value.

Next, we characteristics of GaN schottky diode whose breakdown voltage is 100V were examined by developing half-wave rectifier circuits. It is found that most diodes were normal behavior. Then, three patterns of rectifier circuits were newly developed. First, the rectifier circuit and a heat sink were glued with silver paste. However, the efficiency of this developed circuit was not increased. Second, a condenser was inserted between a diode and a ground. It is found that the efficiency was improved to be about 14.6%. The efficiency was increased about 5 points. Third, a stub was inserted between a diode and a ground. The efficiency was dependent on the stub length. When the stub length was 8mm, the efficiency was about 36.0%. As results, the third rectifier circuit provided the highest efficiency.

References

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