ABSTRACTS (MASTER THESIS)

Study on Receiving Antennas and Safety in Microwave Power Supply System to Vehicle Roof

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We propose a wireless power supply system to the roof of an electric vehicle by using microwave power transfer. Since the system radiates high power microwaves, the unwanted microwave leakage outside of the system must be suppressed for human safety. The leakage is mainly caused by the microwave reflection on the receiving antennas. In this thesis, we analyze the receiving antennas to suppress the reflection.

In addition, it is also necessary to ensure the safety under unexpected situations. We discuss the safety of the system based on the detection devices against the situations. In order to evaluate the microwave reflection on the receiving antennas, the receiving efficiency of the system was investigated. First, the operation of dipole array antennas with reflector for plane wave incidence was analyzed by using FDTD method. The results clarified the effects of mutual coupling on the receiving efficiency, and the receiving efficiency of infinite array antenna reached 99.9% under the matching condition including the effects of mutual coupling. In order to simulate a practical case, we analyzed 12x12 array antenna performances under Gaussian-type microwave incidence. As a result, the receiving efficiency reached 99.9%, and the total microwave leakage outside of the system was reduced to 0.673%. Next, the receiving efficiency was experimentally evaluated. A plane wave was transmitted to 3 x 3 microstrip array antennas to measure the receiving efficiency. The results showed that the receiving efficiency was 77.8% with the element intervals of 0:4λ, and that of 0:5λ was 85.1%. For human safety, the power transmission must be stopped immediately by the detection devices under the unexpected situations. The response speed of the detection devices was measured for the situations of 1) inclined transmitting antennas, 2) object incursion into the transmitted beam. The experimental results clarified the conditions to ensure the safety for the situations.

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