NOBEL DESIGN AND TUNING METHOD FOR THE RESONANCE COUPLING WIRELESS POWER TRANSMISSION FOR IMPLANTABLE BIOMEDICAL DEVICES

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ABSTRACT

Cardiac pacemakers use primary batteries as their power source, and users need to undergo surgery to replace the batteries once every few years, which is a burden on the patient's body. In order to solve these problems, the application of wireless power transmission technology, which is used to charge smartphones, has been attracting attention in recent years.

There are several wireless power transmission methods, but the magnetic field resonance method is often used for medical devices implanted in the body because of its high resistance to positional shift and long transmission distance, and this is the method used in this study.

In this method, the resonance frequency of the transmitter and receiver circuits must be precisely matched in order to achieve highly efficient power transmission, which makes circuit design difficult. In particular, the electrical characteristics of thin receiver coils, which have been widely studied for implantation in the body, are easily affected by electrolytes in body fluids, and in a previous study in academia, it was pointed out that when a receiver coil was chronically implanted in the abdominal cavity of a rat, the L capacitance changed significantly compared to that in air, resulting in a change in the resonant frequency of the transmitter/receiver circuit, and thus significantly lowering transmission The problem that the resonant frequency of the transmitter and receiver circuits changes, resulting in a significant decrease in transmission efficiency was pointed out in a previous study . To solve these problems, methods such as searching for and tuning the changed resonance frequency externally or reviewing the parameters of the circuit elements can be considered.

In this study, we evaluated the performance of a circuit that resonates in a frequency band above the self-resonance of the receiving coil proposed in a previous study. Specifically, we conducted power transmission experiments in saline solution and chicken meat, assuming implantation in the body, and evaluated the performance of the circuit from two aspects: output power and transmission efficiency. In addition, the effectiveness of the new circuit was evaluated using the conventional circuit used in the previous study as a comparison target.