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Abstract
Modern scientific technology is progressive continuously. As we see there have some implantable biomedical microsystems like pacemaker, cochlear hearing device, and neural prosthesis etc. that have been applied to many clinic applications. However, when these microsystems are implanted into human body for a long time, how to maintain their effectiveness and safety is an important issue to investigate. The goal of this study is based on the implantable stimulation and sensing microsystem to design and implement its internal implantable power device (including secondary battery, charging and protection circuits), and then to evaluate its characteristics and suitability.
First, the secondary battery of the power device used a small-size high-power density Li-ion battery with a dimension of 30mm × 20 mm × 4 mm. The capacity of the battery is 120 mAH. The battery charging and protection circuits used the charging ICs (Microchip MCP73828 and MCP73841) and a protection IC to construct. With the implemented power device, then it is used to evaluate if satisfies the requirements of charge/discharge, safety, and life time. On the aspect of off-line evaluation, from the experimental results we find that when the battery is placed in a 37.8℃ thermostat container and is used for an implantable system with 50 mW power consumption, the Li-ion battery should be able to operate for 150 minutes. If operating at a state of 1 hr charging and 1.5 hrs stopping, under such a condition of continuous accelerating life test to make the battery life end capacity left to be 50% of the original capacity, the battery can still work for 6000 ~ 8000 hrs. Further, when the battery is being in the state of charge/discharge, its working temperature is always lower than body temperature. If it’s not used continuously, the working time will increase more. Another, if this battery is not used over 6 months, the battery voltage will drop to a non-working voltage level. Therefore, it is required to be charged at a proper time, and then this action can inhibit the battery from overcharging leading to shorten its life time. Next, on the aspect of on-line evaluation the microsystem was simulated by an external class-E power amplifier to transmit electrical power to the implantable device using an inductive coupling way. When the distance between the coupling coils is within 3 to 5 cm, it can work normally, but when the distance is over 7 cm it can not charge the power device due to the induced voltage being too low. As the power device is charged by a protocol of constant voltage 4.2 V and limited current 0.3 A, it can be charged fully with a time of 43 minutes, and with the maximum temperature of 40.6 ℃ to be generated. As the power device is charged by a protocol of pulse voltage 4.2 V and limited current 0.3 A, it can be charged fully with a time of 60 minutes, and with the maximum temperature of 39.5 ℃ to be generated. Thus, using the former protocol the charging time is shorter, but the maximum

temperature is higher; using the latter protocol the charging time is longer, but the maximum temperature is lower. By these results and system requirements, we can determine the battery capacity and the charging protocol. Finally, from the previous evaluation results, we can conclude that if the power device is packaged further the power device can be combined with other units of an implantable biomedical microsystem for long-term usage.
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