

## Electrosurgical Scalpel by Combining RF Current and Microwave

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In recent years, various types of medical applications of microwave have widely been investigated and reported. In this study, the authors apply thermal effect of the microwave for development of surgical devices. Generally, electric scalpel has widely been used for surgical operation and employs the radio frequency (RF: from several hundred kHz to several MHz) current. It can realize both tissue coagulation and dissection. Therefore, it is employed for wide range of surgical operation nowadays.

By the way, the electric scalpel can sharply incise biological tissue. On the other hand, the device is not good at the tissue coagulation. In order to realize clear coagulation of the tissue, modern electric scalpel system equips several wave forms of RF current. However, fog and tissue carbonization will occur, because the device based on the discharge between the device tip and the tissue. According to our preliminary investigations, a surgical device based on the microwave technology can coagulate the tissue appropriately. Therefore, in this study, an electro surgical scalpel by combining the RF current and the microwave (2.45 GHz) is developed. Moreover, the performances of developed device are evaluated by the numerical calculations based on the finite difference time domain (FDTD) techniques and some experiments by use of extracted organs.

There are many types of electric scalpels depend on the target organs and surgical methods. In this study, a “pencil type” device shown in Fig. 1 is developed. The device tip operates such as a monopole antenna and a metallic block plays a role of electrode for tissue incision by the discharge. The energy source (RF current or microwave) can be selected according to preference of the surgeon.

In order to evaluate the heating performances of the device, specific absorption rate (SAR) and temperature distributions by the microwave energy around the device are calculated. As a result of calculations, high temperature region, which can generate the tissue coagulation, can be observed. Moreover, some experiments using extracted biological tissue are performed. The proposed device could generate the coagulated region by the microwave energy and could incise the tissue by the RF current. As a further study, prototype devices, which can be used for actual surgical treatment, will be developed.

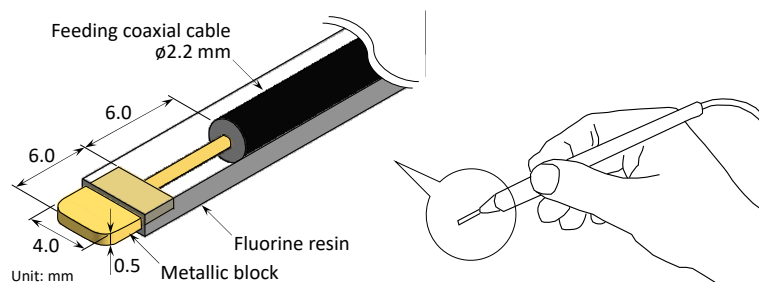


Figure 1. Developed electrosurgical scalpel.