Detection of magnetic nanoparticles in deep position by using pulsed magnetic field

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Breast cancer metastasizes to other organs via lymphatic vessels and lymph nodes. In the case of breast cancer, treatment is different depending on the presence of metastasis, so grasping metastasis is important. In the sentinel lymph node biopsy performed on breast cancer patients, the radioisotope method has been used conventionally, but as an alternative method, a magnetic tracer and a magnetic probe is cited.

In the previous study,[1] the permanent magnet was used as a magnetic field generator, and the signal of the magnetized nanoparticles was measured by the detector up to 9 mm depth from the magnetic probe. Since the permanent magnet can generate only weak magnetic field below several hundreds mT, the magnetic fields generated from magnetic nanoparticles cannot be detected by the magnetic probe when it exceeds 10 mm. In this research, we developed a device to detect the magnetic field from magnetic nanoparticles in deep position by using pulsed strong magnetic field generated by RLC circuit. The influences of the pulsed strong magnetic field on a nerve and myocardium were also estimated.

For example, the capacitance of C = 12.8 mF was charged up to 4500 V, then the magnetic field was generated at the solenoid coil with L = 1.83 mH as shown in Fig. 1. The crowbar circuit can deform the dumped oscillation current as shown in (b). The maximum magnetic field of B = 45 T at the center of the coil was observed at t = 7 ms. The sensitivity and the configuration between the magnetic sensor and solenoid coil were discussed.

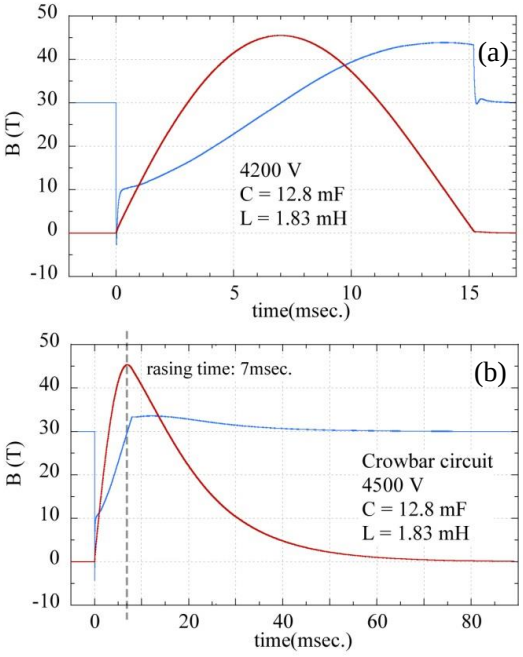

Fig. 1. Waveforms of pulsed magnetic field.

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