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

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Breast cancer is known to have metastasis via lymph vessels and lymph nodes. Metastasis of breast cancer can be judged by sentinel lymph node biopsy (SLNB). Conventionally, the method using radioactive isotope and blue dye was mainstream with a high detection rate in SLNB, but it is dangerous due to radiation exposure. A new method using a magnetic tracer and a magnetic probe attracts attention because of free from the risk of radiation exposure.

In the previous study, permanent magnet was used in the new method [1]. Sekino *et al*. reported that the signal of magnetized nanoparticles was detected up to 9 mm depth from the magnetic probe. Since pulsed magnetic field can be generated a relatively large magnetic field, it is expected to be useful for detecting magnetic nanoparticles in more than 9 mm depth.

We fabricated a compact pulsed magnetic field generator using RLC series circuit to detect magnetic nanoparticles [2]. A search coil as a magnetic probe was fixed on surface of the exciting coil to detect magnetite as a magnetic tracer. Charging and discharging were performed at 200 V to obtain induced electromotive force. Magnetic field and magnetization were calculated from the induced electromotive force according to Eq. (1).

$$B = -\frac{1}{NS}\int V\,dt\,. \quad (1)$$

Detection limit was evaluated to be 8 mm from surface of the excited coil for 47.4 mg magnetite as shown in Fig. 1. We plan to improve the magnetic prove and equipment to increase the detection depth and accuracy.

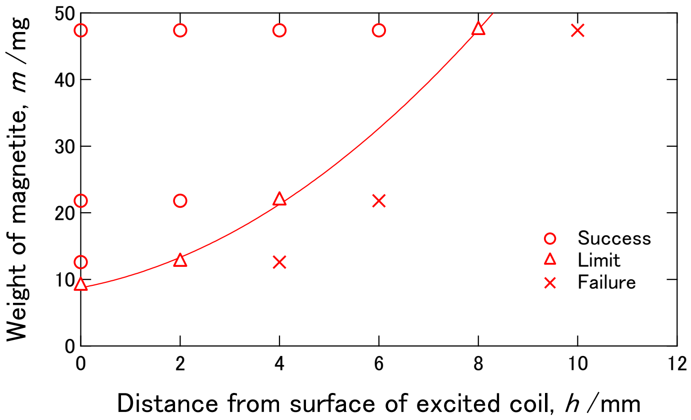

Fig. 1. Detection limits of magnetite.

Acknowledgment: This work was supported partially by JSPS KAKENHI Grant No.16K04946.

References

[1] Masaki Sekino *et al*., Scientific Reports **8** (2018), 1195.

[2] Hiroyuki Nojiri, Kotaibutsuri **37** (2002) pp. 537-544 (in Japanese).