

DT01

Magnetic Characteristics of Nanoparticles in PVA Fiber

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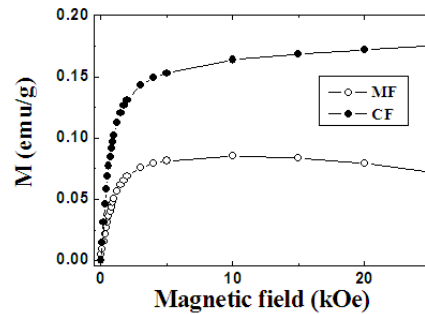
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The magnetic properties of ferritin nanoparticle embedded into polyvinyl alcohol (PVA) fibers were investigated according to the heat treatment of the mixed PVA-ferritin solution. The ferritin-embedded PVA fibers with a diameter of about 100 nm were fabricated by the electrospinning method at room temperature[1]. While the mono-dispersed ferritin (MF) has been formed from the solution kept at room temperature, the clustered ferritin (CF) has been obtained from the solution stirred for 10 min at 800°C. The morphological difference between MF and CF samples was studied by high-resolution transmission electron microscopy (HR-TEM) and scanning electron microscopy. The magnetic properties of ferritin-embedded PVA nanofibers were also investigated by using a superconducting quantum interference device magnetometer. The magnetic susceptibilities χ_{DC} and χ_{AC} were measured and analyzed by employing a physical property measurement system. The HR-TEM image shows that the giant clusters in CF sample are composed of a large number of ferritin nanoparticles. Even though the size is significantly large, the CF sample exhibits a superparamagnetic behavior.

The M(H) results show that the saturated magnetization of CF becomes much larger than that of MF. The magnetic phase of ferritin core was partly changed, depending on the heat treatment temperature. To elucidate the electronic structures of the ferritin cores at different heat treatment temperatures, x-ray absorption spectroscopy (XAS) was carried out with an energy resolution of 0.8 eV in the total electron yield mode. From the XAS result, it was observed that the ionic state of Fe core has been changed from Fe²⁺ to Fe³⁺ after the heat treatment. The obtained results provide us a possibility to manipulate the size and the magnetic ordering inside a biocompatible superparamagnet and to realize the biomedical electric devices.



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DT02

Resonant Circuit for Hyperthermia Implant Using Planar Coil Structure

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Hyperthermia is a cancer treatment of raising the body temperature. It has an advantage that there are not major side effects as compared with various established treatments, such as surgical operation, radiotherapy and chemotherapy. It has been known that a survival rate of the cancer cells drops sharply at 42.5 deg. C. In addition, the temperature of cancerous tissue rises more easily than that of normal tissues because of poor cooling by a sluggish blood flow. The hyperthermia using implants has been reported in term of its ability to control the temperature of cancerous tissues, and a possibility to warm them locally^{[1][2]}. A resonant circuit, which is heated efficiently by an external magnetic field, is one of candidates for the implants^[3].

We have reported preliminary results on a temperature rise of resonant circuits excited by a magnetic field from commercial MRI equipment^[4].

In this study, structure of coil consisted the resonant circuits are investigated. Fig. 1 shows the measured temperature rise of the resonant circuit consisting planar coil. The planar coil is promising for miniaturization of the resonant circuit. The size of the coil was 6 mm by 10 mm. The resonant circuits were heated by applying an ac magnetic field. The field strength was 2.7 A/m (3.4 μ T). The exciting field was a continuous alternating wave at 62.7-63.1 MHz. The resonant circuit consisting of planar coil of $L = 1.14 \text{ } \mu\text{H}$ and capacitor of $C = 5.6 \text{ pF}$ was used in this measurement. Its resonant frequency was 62.9 MHz. The circuit covered by polyurethane material as a thermal insulation was heated up to 12 deg. C.

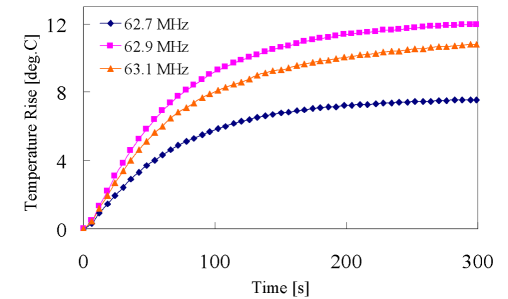


Fig. 1. Temperature rise of the resonant circuit consisting of planar coil of $L = 1.14 \text{ } \mu\text{H}$ and capacitor $C = 5.6 \text{ pF}$. The resonant frequency was 62.9 MHz. The wire diameter of the coil was 0.1 mm.

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