QD08

Hysteresis Loss in Self-temperature Rising of Magnetic Nanoparticles for Hyperthermia Applications

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Hyperthermia is a therapeutic procedure of raising the body temperature for cancer. It has an advantage that risks of scar and harmful side effects are reduced, which is not achieved by various established treatments of surgical operation, radiotherapy and chemotherapy. There are various methods of heating the body temperature for hyperthermia. Among them, magnetic nanoparticles are promising as they can be injected into the body. In this paper, hysteresis loss in self-heating temperature rise of magnetic nanoparticle is discussed.

The samples were $NiFe_2O_4$ [1], $CoFe_2O_4$ [2] and other ferrite nanoparticles of 35 nm. Temperature rise of the particles was measured by applying ac magnetic field at a frequency of 30-210 kHz. The field strength was varied between 40 to and 140 Oe. The quantitative analysis of the hysteresis loss is discussed in this paper. The applied field strength dependence of the self temperature rise is a significant measurement in order to understand the contribution of hysteresis loss and other contribution such as "Néel rotation". We have succeeded to distinguish these contributions quantitatively. It has been confirmed that the physical mechanism of self-heating is mainly attributed to the hysteresis loss in the measured samples. It has been also found that the self-heating temperature is linearly increased by increasing frequency. The maximum temperature rise of $CoFe_2O_4$ nanoparticle was as high as 16 deg. C which was achieved by the applied field of 140 Oe at 110 kHz. The applied field dependence of the temperature rise was proportional to the factor of $H^{2.5}$, where H was a field strength. This field dependence was consistent with the calculation of the hysteresis loss of the particle. We could obtained a similar result on $CoFe_2O_4$ nanoparticle. The particle size dependence and other ferrite nanoparticles are also reported in the presentation.

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QD09

Monodispersed MFe_2O_4 (M=Cu, Co, Ca, Ni) Nanoparticles for Applicationin Biomedicine: Preparation, Characteristics, and in vivo Studies

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There have been many studies [1-3] about the magnetite nanoparticles used in tumor diagnostic and treatment up to date, only few researches about the radioactive magnetic fluids have been investigated. In such researches, the radioactive element was absorbed onto the surface of magnetic particles [3]; the labeled radioactive element was unstable and broke away easily from the particles. Therefore, more studies have been necessary for improvement in this part.

The monodispersed hydrophilic magnetic fluids with nanometric MO • ferrite (M=Cu, Co, Ca, Ni) particles were prepared by the sonochemical method. The substituted amounts of M elements were analyzed with different x values by ICP-AES quantitatively for $M_xFe_{3-x}O_4$ particles. The biological experiments were performed to observe the proper dosage and the toxicity by using S.D. rat with different core sources.

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