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Drug localization by magnetic fluids of $Cu_xFe_{1-x}OFe_2O_3$

Chungnam National University S. I. Park*, Y. Q. Huang, C. O. Kim

Research Center for Advanced Magnetic Materials J. H. Kim

1. Introduction

Studies on drug delivery using nano-size particles of magnetic fluid and hyperthermia have been performed by some researchers [1] because interests in human health increased according to industry development. However, there are few studies on systems which can accurately control delivery of the magnetic fluids to a diseased part of body [2].

In this study, Cu-added magnetic ferrofluid was prepared and the external magnetic field system was designed for drug localization.

2. Experimental

The magnetic fluid was prepared by a two-step method. In the first step, the mixed solution of $CuCl_2$, $FeCl_2$ and $FeCl_3$ was heated to 80℃ with continuous stirring, and was precipitated with an excessive alkali reagent. In the second step, the precipitate was coated with decanoic acid, was washed with acetone and water, and then were coated with nonanoic acid.

The magnetic field system was designed with C-core type, which was required when the magnetic fluid was applied to clinical test. The gradient of strong magnetic field was generated by repulsion of the same poles [3]. The field distribution was analyzed with 2-D and 3-D analytical models of the Maxwell program (Ansoftkorea Co.).

3. Result and discussion

Figure 1 shows that the magnetization of the magnetic fluid decreased with increasing substitutional copper contents. The reason is that amount of the ferromagnetic phase in the particles decreases while the diamagnetic copper element substitutes Fe^{2+} position in the Fe_3O_4.

Figure 2 shows that magnetic fluid is positioned at the center of a miniaturized system. The fluid was inserted into glass tube of 1cm diameter. Therefore, this system can collect the magnetic fluid within local region when the fluid is injected into body.

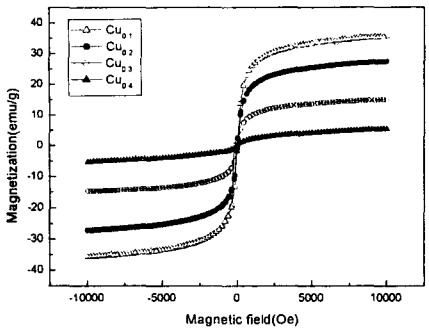

Fig. 1. Magnetization curves of magnetic fluid with magnetite nanoparticles substituted by different copper contents.

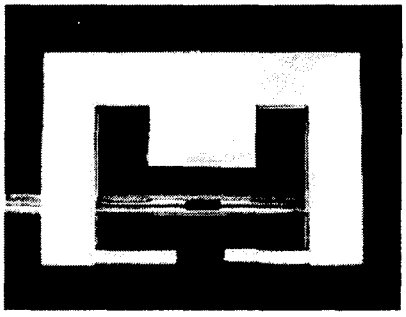

Fig. 2. Application of magnetic fluid to field system for drug delivery.

4. Conclusions

The copper ion substituted partly Fe^{2+} in Fe_3O_4 crystallite. The magnetization of the prepared nanoparticles decreased with increasing substitutional quantity of diamagnetic copper. The magnetic particles were well dispersed in the water with tetramethylammonium hydroxide as dispersant.

The magnetic fluid could be positioned at local region when it was applied to practical system.

5. Reference

[1] Jones, S K et al., Physics in Medicine and Biology, vol. 46, 2 (2001) 385

[2] M. B. Bever, "Encyclopedia of Materials: Science and Engineering, 4th ed.", MIT press, (1986). p.2677

[3] Rollin J. Parker et al., Permanent Magnets and Their Application, (1962) 101