QD02

Permanent Magnets Circuit For Collagen Orientation

T.shinohara[1], T.Saito[2], D.Saito[1], M.Kotani[2], and M.Aoki[3]

[1]Research Center for Advanced Technologies, Tokyo Denki University
[2]Graduate School of Engineering, Tokyo Denki University
[3]NEOMAX Co, Ltd

Corresponding author: shinohara@rcat.dendai.ac.jp Phone:81 0476 46 8219,Fax:81 0476 46 8237

Introduction

As the life span of human beings is becoming increasing longer, the number of people with bone problems is also increasing. Biomaterials such as ceramics and metals are used for repair and reconstruction of diseased or damaged skeleton systems. However, the mechanical and biocompatible characteristics of these materials are different to those of natural bones. Therefore, the development of biomaterials with characteristics similar to those of natural bone is expected.

Recently, several studies have been reported on bone tissue engineering[1]. One of the key technologies is collagen orientation. It is reported to orient collagen by high magnetic field of superconducting magnets[2]. But the use of superconducting magnets is high cost and needs complex operation procedures. So we have been studying to use permanent magnets circuit for collagen orientation[3].

Experiments

The permanent magnets circuit was designed to obtain higher magnetic field strength in wider area without heavy weight. The circuit is consisted with Nd-Fe-B magnets. The center of circuit with high Hc and outer of circuit with high Br magnets were arranged. The high saturation magnetization material Co-V-Fe alloy was used for pole pieces. The magnetic circuit system is shown in Fig1.

Collagen (Type I from pig) , NaCl and DME medium with 8% are mixed then applied magnetic fields by permanent magnet circuit, then kept 37°C for 4 hrs in incubator of CO2 density 5%, then observed by optical microscopy. The orientation order of the collagen defined as $f2D=2\{(\cos 2\theta)-1/2\}$. θ defined as the angle between the collagen orientation and vertical direction to applied field.

Results and discussions

The maximum magnetic field strength of newly developed permanent magnets circuits was 3.0 T, and area field strength more than 2.6T was as wider as 30×30mm^2.The collagen orientation was observed clearly vertical to applied magnetic fields as shown in Fig 2. The orientation order ratio was around 0.8. As the results, using the permanent magnets circuit equipment, neither helium nor nitrogen nor complex operation, realized. The collagen orientation processes will be simple and energy saved and low cost.

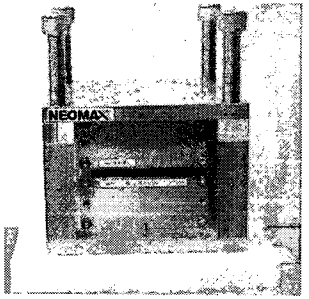

Fig. 1.

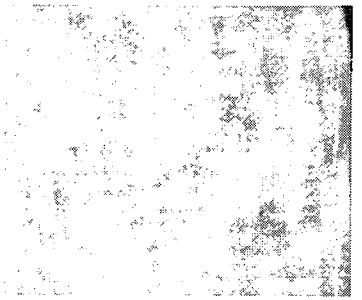

Fig. 2.

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QD03

Size control (50-150 nm)of spherical monodisperse ferrite nanoparticles for biomedical applications

Toshiyuki Tanaka*[1,2], Ryuichi Shimazu[1], Masaru Tada[1], Takashi Nakagawa[1], Adarsh Sandhu[3], Hiroshi Handa[4], Masanori Abe[1]

[1]Department of Physical Electronics, Tokyo Institute of Technology, 2-21-1 Ookayama, Meguro-ku, Tokyo, Japan
[2]System Engeneering Section, Motortronics Laboratory, Tamagawa Seiki Co., Ltd., 1020 Kega, Iida City, Nagano Prefecture, Japan
[3]Quantum Nanoelectronics Research Center, Tokyo Institute of Technology, 2-21-1 Ookayama, Meguro-ku, Tokyo, Japan
[4]Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology, 4259 Nagatsuta-cyo, Midori-ku, Yokohama, Japan

*Corresponding author: tanaka.t.as@m.titech.ac.jp, Phone: +81 3 5734 2199, Fax: +81 3 5734 2906

Monodisperse ferrite nanoparticles with spherical shape are required for use as high performance magnetic carriers for a variety of biomedical applications. Spherical ferrite particles have no specific dominating crystal planes, which makes them highly dispersed in water (because no intersurface adhesion occurs) and their surfaces uniformly conjugated with bioactive molecules. We [1] have reported that in an aqueous synthesis of ferrite (intermediate between Fe_3O_4 and γ-Fe_2O_3) nanoparticles, spherical shaping and monodispersion are facilitated by adding a carbohydrate and seed nanocrystals (3-8 nm in diameter). In this paper we will report we can controlaverage diameter of the monodisperse spherical ferrite particles by changing the carbohydrate and the amount of the seed crystals.

Figure 1 shows that adding carbohydrates "A," "B," "C," "D," and "E" yielded monodisperse average diameters 52 ± 9 nm, 78 ± 11 nm, 96 ± 11 nm, 108 ±16 nm, and 156 ± 13 nm, respectively. And increasing the amount of the seed crystals by factor 5 (in synthesis using carbohydrate "E") produced smaller particles, 57 ± 9 nm in diameter. All our spherical nanoparticles had saturation magnetization of magnitude comparable to that reported for balk samples. Thus we have established a method to prepare monodisperse spherical ferrite particles with average diameters of 50-150 nm, which are promising high performance in magnetic carrier application in biomedical field.

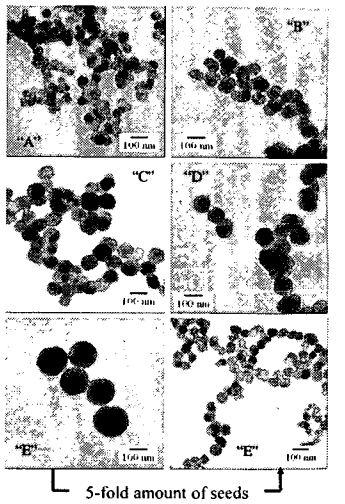

Fig. 1. TEM images for ferrite nanoparticles synthesized using carbohydrates "A"-"E" and seed crystals. Comparison is given for "E" when amount of seed crystals was changed by factor 5.

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