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BOOK REVIEW

Scientific and Clinical Applications of Magnetic Carriers, U. Häfeli, W. Schütt, J. Teller and M. Zborowski (Eds.), Plenum Press, New York 1997, 644 pp., US$149.50.

Based on proceedings of the first conference on magnetic carriers held in 1996 in Rostock, Germany, this book reviews the recent developments in the field of medical and biological applications of magnetic carriers and magnetic fluids. For the engineering fraternity this is a fascinating area of applied magnetism and even a brief perusal of the book will reveal a considerable potential for the application of the physical and engineering principles of magnetism in medicine and biology.

The book is divided into eight sections, devoted to the following topics: (1) Preparation and modification of biodegradable magnetic particles, (2) Characterisation of magnetic particles, (3) Application in cell separation and analysis, (4) Applications in molecular biology, (5) Biomedical applications of magnetic carriers, (6) Drug delivery and radionuclide therapy, (7) MRI contrast agents and (8) Hyperthermia.

Most contributions are very interesting to read, although medical and biological details and jargon may cloud the full understanding of the value of new research findings. C. Grüttner *et al.*, for instance, describe the synthesis of new biodegradable magnetic nanospheres for the application in magnetic field-assisted radionuclide therapy. For this purpose, iron oxide cores were coated with hydrophilic polymers. To ensure the complexation of radionuclides, chelating agents were bound to the surface of the particles. W. Schüppel *et al.* show how glass crystallisation could be used for preparation of nanocrystalline oxide media. These particulate systems can be used, for instance, in novel ferrofluids and in the biomedical field. M.P. Pileni *et al.* describe how by using oil in water micelles; it was possible to make inverted spinel ferrite nanosized particles. Control of particle size was achieved by small changes in the experimental conditions, thus permitting an evaluation of the relation between a particle size and their magnetic properties.

M. Zborowski *et al.* describe the feasibility study of continuous magnetic cell sorting using an immunomagnetic colloid and two magnetic field configurations, namely dipole and quadrupole. M. Bosnes *et al.* discuss the use of magnetic beads in molecular biology. Superparamagnetic beads have been demonstrated to be a valuable tool for isolation, identification and genetic analysis of specific cells and for detection of pathogenetic bacteria and viruses. Magnetic separation, either manual or automated, was found to be an efficient way of handling such beads. I. Safarik and M. Safarikova give a review of magnetic separation as used in biochemical and biotechnological applications. This technique can be used for the immobilisation, isolation, modification, detection and removal of biologically active compounds and cells.

Hao Yu developed magnetic immunoassay for the detection of virulent bacteria from biological samples. Immunomagnetic carriers were used for bacteria capture. These immuno-activated magnetic beads can be separated from the sample media after the agent is captured. Separation is achieved in two types of magnetic separators. The first is a flow-through permanent magnet-based immunomagnetic separator filled with steel wool. The second is a magnetic plate separator, which was developed for immunomagnetic separation in a multiple sample format. Development of magnetic particles, which selectively bind to tuberculosis bacilli and can then be extracted by a magnetic separator, is described by M.A. Vladimirsky *et al.* A.A. Kuznetsov *et al.* discuss the development of ferro-carbon particles that are used as magnetic adsorbents for the guided delivery of drugs. These particles consist of a magnetic core coated with carbon. The carbon phase is porous and has a large specific surface area. By a judicious arrangement of magnets around an organism, it is possible to focus magnetic particles inside the organism and to concentrate them in a tissue located deep inside the body. For instance, two orders of magnitude higher concentrations of anti-cancer antibiotics can thus be created in the tumour compared to other organs.

Development of magnetic nanospheres for localised drug delivery to brain tumours is presented by S.K. Pulfer and J.M. Gallo. The therapeutic ineffectiveness of chemotherapy for brain tumours is caused by limited accessibility of the tumour and lack of drug diffusion through normal brain tissue to the tumour site. Magnetic drug-loaded particles were found to overcome many of the obstacles and to improve selective delivery of cytotoxic agents to the tumour site. A.S. Lübbe and C. Bergmann describe the first clinical experience with magnetic drug targeting in patients with advanced tumours. Ferrofluid that was used as a vehicle to concentrate a drug locally in tumours contained a 1.5% concentration of magnetite with a particle size of 100 nm. Custom-shaped Nd–Fe–B permanent magnets were used to localise the ferrofluid. It was observed that the treatment with magnetic drug targeting did not harm the patients and appeared to be safe. It was also found that the size of magnetic particles seemed to be the key determinant to increase the accumulation of magnetite and thus of the drug in tumours. Particle sizes up to 1 μm show significant advantages.

A new concept for the treatment of AIDS infection is described by D. Müller-Schulte *et al.* A simple heat treatment was used to irreversibly inactivate the AIDS virus. Temperatures in excess of 50°C required for the virus inactivation were achieved by inductively heating magnetoliposomes. Magnetoliposomes, magnetic particles of diameter smaller than 200 nm, encapsulated in liposome, were injected into the patient. After the attachment of magnetoliposomes to the target organs (HIV and infected cells), the particles were inductively heated by an external high-frequency AC magnetic field. A review article on magnetic fluid hyperthermia is presented by A. Jordan *et al.* The heating of organs and tissues is a well-established technique for the treatment of cancer. In addition to conventional hyperthermia techniques, inductive heating of magnetic fluids by AC magnetic field is becoming a promising alternative approach.

There are numerous other papers of considerable interest to an engineer or a physicist. The common feature of most of the papers is a rather naïve approach to the design of the magnetic systems, characterisation of the properties of magnetic particles and the overall understanding of the physical mechanisms of particle behaviour.

There are one or two rather ambitious papers in this book that try to survey the fundamentals of magnetism. This effort is of limited relevance to the subject of the conference, is often inconsistent and introduces confusion rather than clarification of the fundamentals of magnetism.

The quality of production of the book is very good: high-grade paper, excellent drawings and photographs, printing and binding. The publication is a valuable contribution to the reading list of anybody who is interested in applied magnetism, and numerous opportunities are clearly waiting for those who prepared to delve deeper into this exciting field of magnetic research.

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