

## Progress in applications of magnetic nanoparticles in biomedicine

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## EDITORIAL

# Progress in applications of magnetic nanoparticles in biomedicine

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In 2003 *Journal of Physics D: Applied Physics* published three sequential review articles on the subject of biomedical applications of magnetic nanoparticles. At that time there was growing interest in basic research on the potential of magnetic nanoparticles in biomedicine, including the appropriate methods to synthesize the particles and how to functionalize them. Following that initial publication the field has burgeoned and is now of a scale that could never have been envisaged in 2003.

In the original review articles the authors anticipated applications in three specific technical areas of drug delivery and cell separation, MRI contrast enhancement and hyperthermic heating of biological materials, either for cell destruction or to increase the efficacy of other associated treatments such as chemotherapy. Six years later, significant progress has been made in all three areas, with applications already having been realized. More significantly, *in vivo* applications of both MRI contrast and hyperthermic cell heating have been achieved in human patients.

## The original 2003 reviews

Q A Pankhurst, J Connolly, S  
K Jones and J Dobson

### **Applications of magnetic nanoparticles in biomedicine**

2003 *J. Phys. D: Appl. Phys.*  
**36 R167–181**

Pedro Tartaj, María del  
Puerto Morales, Sabino  
Veintemillas-Verdaguer,  
Teresita González-Carreño  
and Carlos J Serna

### **The preparation of magnetic nanoparticles for applications in biomedicine**

2003 *J. Phys. D: Appl. Phys.*  
**36 R182–197**

Catherine C Berry and Adam  
S G Curtis

### **Functionalization of magnetic nanoparticles for applications in biomedicine**

2003 *J. Phys. D: Appl. Phys.*  
**36 R198–206**

This rapid progress in such a complex field is due to the need for non-invasive therapies and more effective management of serious conditions than is possible by the simple use of drugs alone. Imaging techniques such as MRI have also improved beyond all expectation and hence the possibility of improved contrast is particularly appealing. However, none of these applications could have been realized without dramatic progress beyond the state of the art in 2003 in the areas of particle synthesis and functionalization. Hence, remarkable progress has been made in all areas of the physics, chemistry and biochemistry of this subject, leading to many publications and perhaps a ten-fold increase in the number of those actively involved in research in this area.

In 2003 we were most fortunate to have several expert authors review the subject. Quentin Pankhurst, Puerto Morales and Catherine Berry are now recognized as leaders within their own areas of the field. Because that field is moving rapidly and has now become a major subject of study, we believe that a collection of updated reviews would be highly appropriate and beneficial to the community. We have been fortunate in getting the same authors to provide six-year updates of their original works. This offers continuity and also allows those who may be new to this area to refer back to the original reviews for a full description of the basic science. In the interests of economy and to avoid repetition, this new set of reviews should be read in conjunction with the original works.

The Editorial Board of *J. Phys D* is particularly grateful to the authors for agreeing to write a second work for our journal. We are aware that the production of reviews is an onerous task and acknowledge their efforts in making available such clear and high quality papers. We trust these new works will prove as beneficial to readers and as successful for their authors as were their original reviews.