Magnetic Nanoparticles Properties Synthesis And Applications Physics Research And Technology

Self Organization Magnetic Arrays (SOMA) made from self-assembled magnetic nanoparticles produced by solution phase chemical approaches have been considered as the most promising candidate for ultra-high density magnetic recording media with potential areal density beyond 1Tb/in2. This thesis is focused on the fabrication of CoPt and FePt-type nanoparticles by chemical synthesis for the application in magnetic recording media. The work in this thesis consists of

three parts. Synthesis and characterization of CoPt and FePt nanoparticles were investigated.

This book summarizes recent progress due to novel functionalized magnetic nanoparticles in the analytical chemistry arena and addresses the challenges for their use in that area.

Magnetic nanoparticles (MNPs) are one of the materials of great interest for presenting a unique combination of relevant properties such as high surface area, magnetic behavior and low toxicity, which can find potential use in different processes and applications in areas such as catalysis, data storage, water treatment, drug delivery system, DNA separation, tissue engineering, sensors, hyperthermia, ferrofluids, and as contrast agents in nuclear magnetic

resonance (NMR) imaging. This book provides further information on how magnetic nanoparticles are synthesized, their physicochemical properties and the roles MNPs play in biomedicine. (Imprint: Nova)

From the fundamental point of view, NPs formed by MFe2O4 with (M= Co, Fe) are ideal system models to study the new magnetic phenomena associated with the so-called particle-like behaviour, which emerges from the size reduction towards the nanometre scale and contrasts with the well-established magnetic properties of their bulk-counterparts. It is well known that most of the particle-like behaviour and in general the large variability of the magnetic properties observed in this kind of nanomaterials are related to structural features of the NPs rather than being originated from intrinsic

finite-size or surface effects, at least for NPs bigger than a few nanometers. These structural features, such as crystallographic defects, polycrystalline nature of the NPs, lack of crystallinity at the particle surface, etc., have strong influence on their magnetic properties and can be modified at will through the synthesis method. Therefore, whenever this particle-like behaviour is unwanted for applications with highly demanding requirements, the choice of a suitable synthesis method is of key importance to obtain NPs of high-crystalline quality. On the contrary, particle-like behaviour controlled by the crystalline nature of the NPs could be useful to tailor their magnetic properties for specific applications. Among the common synthesis methods, high-temperature decomposition of metal-organic precursors results the best alternative due to

the remarkable final properties of the obtained NPs, such as narrow size distribution, high crystallinity and relatively simple tuning of their size and shape. So this will be the chemical route chosen in this work to study the capabilities of this synthesis method to control the final properties of the NPs through their nanostructure. In addition, to get a deeper insight in the magnetic and structural properties of those materials and to shed light on relevant issues that are still under discussion (dynamic response, magnetic frustration or inter ¬ particle interactions) it could be useful to combine experimental techniques enabling the characterization of the system from macroscopic scales towards single-particle structures. Within this framework, we present this work that is divided into three main parts. First, it is studied the effect of

the concentration of two common reactants, involved in the thermal decomposition method, on the final properties of magnetic NPs based on iron oxides aiming at optimizing the synthesis procedure and getting a good control of the structure of the final product. In the second part, those NPs obtained in the former way are applied to demonstrate the crucial role of the nanostructure on the physical properties of nanoparticulate systems; specially, the strong interplay existent between structure and both magnetic frustration and interparticle interactions. Finally, in the third part, MFM experiments with an external applied magnetic field have been performed to directly observe the reversal of the magnetization of isolated particles and the dynamic behaviour of small aggregates.

Ferrite

Fundamentals, Synthesis and Applications

Stable Colloids of Magnetic Nanoparticles and Nanoparticle Assemblies with Controlled Size and Magnetic Resonance Properties

Magnetic Nanoparticles

Advances in Magnetic Materials

Magnetic Nanomaterials

Ferrites are highly interesting high-tech materials. The book covers their classification, structure, synthesis, properties and applications. Emphasis is placed on biomedical applications, degradation of organic pollutants, high frequency applications, photocatalytic applications for wastewater remediation, solar cell applications, removal of

organic dyes and drugs from aquatic systems, and the synthesis of hexagonal ferrites. Keywords: Ferrite, Spinel Ferrite Nanoparticles, Biomedical Applications, Ferrite Based Heterojunction, Photocatalytic Degradation of Organic Pollutants, Nickel-Zinc Ferrites, Spinel Ferrite Based Nanomaterials, Water Remediation, Magnetic Nano Particles, Wastewater Treatment, Piezo-Phototronic Effect, Ferrite Based Solar Cells, Aurivillius Based Ceramics, Hexagonal Ferrites.

Details the frontier of magnetic nanotechnology from the persepctive of scientists, engineers and physicians that have shaped this unique and highly collaborative field of research.

Nanoparticles for Biomedical Applications: Fundamental Concepts, Biological Interactions and Clinical Applications

brings into one place information on the design and biomedical applications of different classes of nanoparticles. While aspects are dealt with in individual journal articles, there is not one source that covers this area comprehensively. This book fills this gap in the literature. Outlines an in-depth review of biomedical applications of a variety of nanoparticle classes Discusses the major techniques for designing nanoparticles for use in biomedicine Explores safety and regulatory aspects for the use of nanoparticles in biomedicine

Nanomaterials are important tools for enabling technological progress as they can provide dramatically different properties as compared to the bulk counterparts. The field of nanoparticles is one of the most investigated within

nanomaterials, thanks to the existing, relatively simple, means of manufacturing. In this thesis, high-power pulsed hollow cathode sputtering is used to nucleate and grow magnetic nanoparticles in a plasma. This sputtering technique provides a high degree of ionization of the sputtered material, which has previously been shown to aid in the growth of the nanoparticles. The magnetic properties of the particles are utilized and makes it possible for the grown particles to act as building blocks for self-assembly into more sophisticated nano structures, particularly when an external magnetic field is applied. These structures created are termed " nanowires " or " nanotrusses ", depending on the level of branching and inter-linking that occurs. Several different elements have been investigated in

this thesis. In a novel approach, it is shown how nanoparticles with more advanced structures, and containing material from two hollow cathodes, can be fabricated using high-power pulses. The dual-element particles are achieved by using two distinct and individual elemental cathodes, and a pulse process that allows tuning of individual pulses separately to them. Nanoparticles grown and investigated are Fe, Ni, Pt, Fe-Ni and Ni-Pt. Alternatively, the addition of oxygen to the process allows the formation of oxide or hybrid metal oxide – metal particles. For all nanoparticles containing several elements, it is demonstrated that the stoichiometry can be easily varied, either by the amount of reactive gas let into the process or by tuning the amount of sputtered material through adjusting the electric power

supplied to the different cathodes. One aim of the presented work is to find a suitable material for the use as a catalyst in the production of H2 gas through the process of water splitting. H2 is a good candidate to replace fossil fuels as an energy carrier. However, rare elements (such as Ir or Pt) needs to be used as the catalyst, otherwise a high overpotential is required for the splitting to occur, leading to a low efficiency. This work demonstrates a possible route to avoid this, by using nanomaterials to increase the surface-to-volume ratio, as well as optimizing the elemental ratio between different materials to lower the amount of noble elements required.

General, Structural and Magnetic Properties, Synthesis and Functionalization

Tailored Magnetic Nanoparticles for in Vitro, in Vivo and in Situ Magnetorelaxometry

Advances in Synthesis and Applications

Magnetic Nanoparticle-Based Hybrid Materials

Magnetic Nanostructured Materials

Analytical Applications of Functionalized Magnetic Nanoparticles

The present book covers all research areas related to magnetic nanoparticles, magnetic nanorods, and other magnetic nanospecies, their preparation, characterization, and various applications, specifically emphasizing biomedical applications. The chapters written

by the leading experts cover different subareas of the science and technology related to various magnetic nanospecies—providing broad coverage of this multifaceted area and its applications. The different topics addressed in this book will be of great interest to the interdisciplinary community active in the area of nanoscience and nanotechnology. It is hoped that this collection and its various chapters will be important and beneficial for researchers and students working in various areas related to

bionanotechnology, materials science, biosensor applications, medicine, and many others. Furthermore, this book is aimed at attracting young scientists and introducing them to this field, in addition to providing newcomers with an enormous collection of literature references.

The design and development of nanoparticles is of great interest in the current energy and electronic industry. However, based on the current materials available the production cost can be high with insignificant magnetic

and mechanical properties. Specifically, rare-earth magnetic materials composed of neodymium and samarium are known for their high magnetic performance, however, due to the cost of development there is a need to develop a versatile and cost effective material. Alternatively, cobalt carbide nanomaterials have shown to be a promising alternative for rare-earth free magnets as they exhibit comparable properties as hexaferrite magnetic materials. The primary goal of this dissertation focuses on the

development of nanoparticles for permeant magnetic, and magnetic refrigeration applications. The first part of this work focuses on the synthesis of cobalt carbide (CoxC, x=2,3) nanoparticles using a novel polyol synthesis method by introducing a small amount of Ru, Cu, or Au as nucleating agent. It was found that the morphology and magnetic properties of the as-synthesized CoxC nanoparticles change as a result of directional growth of nanoparticles using nucleating agents. Needle-like particle

morphology ranges from 20-50 nm in width and as long as 1 [micro]m in length were synthesized using Ru as nucleating agent. These particles exhibit magnetization saturation of 33.5 emu/g with a coercivity of 2870 Oe and a maximum energy product 1.92 MGOe (BHmax) observed. Particle morphology is a critical aspect in the development of magnetic nanoparticles as anisotropic particles have shown increased coercivity and magnetic properties. These CoxC nanomaterials have a higher maximum

energy product compared to previous work providing further insight into the development of non-rare earth magnetic material. The second part of this dissertation work focuses on the sol-gel synthesis of perovskite LaCaMnO3(LCMO) nanomaterials. In this process, various chain lengths of polyethylene glycol (PEG) was added into a solution consisting of La, Ca, and Mn salts. The solution was left for the gelation process, and high temperature sintering to obtain the final product. By varying the polymer chain of the

PEG, the size of the as synthesized LaCaMnO3 nanomaterials were altered. The as-synthesized LCMO nanomaterials have shown a maximum change in magnetic entropy (-[delta]Sm) was found to be 19.3 Jkg−1K−1 at 278 K for a field change of 0-3 T and 8.7 Jkg−1K−1 for a field change of 0-1 T. This is a significant improvement in comparison to current literature of the material suggesting that this is a promising alternative to Gd materials that is prone to oxidation. With additional development, LCMO or related

maganites could lead to application in commercial technologies.
Magnetic nanoparticles show promise in a vast array of devices that utilize control of nano magnetism. For these devices to properly function, the magnetic properties of the nanomaterials must be precise and uniform across the synthesized materials. The focus of the work that is presented here is to develop ways of characterizing nanoparticles to better understand the materials. Further to the work is to show how to create improved

nanoparticles which can be used in eventual nanoscale magnetic devices. The first three chapters of this work show ways to improve the nanoparticle materials used in eventual nanoparticle based magnetic devices. Chapter one is concerned with improving a method for adhering nanoparticles to surfaces to later manipulate their magnetic moments. The method alters a synthetic method for nickel nanoparticles to remove a phosphorus impurity allowing for an air-free adhesion method. Thus, the method avoids oxidation

damage to the nanoparticle magnetic properties. The second chapter displays the development of a new nanoparticle synthetic method for cobalt ferrite nanoparticles. The new method improves size dispersity and shows a higher degree of size control. Further, the magnetic properties of these crystals are shown to be superior. The third iv chapter shows the adaptation of a known magnetostrictive material galfenol, an iron gallium alloy, into a nanoparticle. This is the first synthesis of such a material as a

processable solution nanoparticles and is shown to be able to be adhered to surfaces using the methodology in chapter 1. The remainder of the chapters of this work are methodologies of measuring nanoparticles to generate a better understanding of the structure of those nanoparticles and how this can help improve magnetic nanoparticle systems downstream. Chapter 4 involves using combined surface sensitive and bulk stoichiometry measurements to create a picture of the nanoparticle atomic distribution.

The example system of annealing of FePt nanoparticles is used to show the value of this method. Finally in Chapter 5 a novel mathematical fitting of nanoparticle anisotropy distributions is shown. This method is used to calculate a temperature dependent anisotropy constant inherent to the chemical structure of the nanoparticles revealing important information about the synthetic process. Further surface and shape anisotropies are propped to provide a fuller picture of nanoparticle quality and thus

understand methods of improving synthesis. This brief offers a comprehensive discussion of magnetic targeted drug delivery of silica-coated nanodevices. Focusing on the latest trend in pharmaceutical applications of these nanodevices, a multidisciplinary overview is displayed, from synthesis and design to pharmacokenetics, biodistribution and toxicology. Chapters include design of silica-coated magnetic nanodevices; techniques for drug loading with features applicable to biological systems; synthesis, characterization

and the assessment of biomedical issues with both in vitro and in vivo experiments. Applications in the treatment of different localized diseases are also addressed in order to present the potential use of these nanosystems as global, commercially available therapeutics.

Synthesis, Functionalization and Application

Synthesis and Characterization of Magnetic Cabides and Oxides Nanomaterials

Applications in Catalysis and Life Sciences

Silver Micro-Nanoparticles

Physical and Chemical Properties of Nanoparticles

Nanoparticles in Catalysis

Magnetic Nanostructured Materials: From Lab to Fab presents a complete overview of the translation of nanostructured materials into realistic applications, drawing on the most recent research in the field to discuss the fundamentals, synthesis and characterization of nanomagnetics. A wide spectrum of nanomagnetic applications is included, covering industrial, environmental and biomedical fields, and using chemical, physical and biological methods. Materials such as Fe, Co, CoxC,

MnGa, GdSi, ferrite nanoparticles and thin films are highlighted, with their potential applications discussed, such as magnetic refrigeration, energy harvesting, magnetic sensors, hyperthermia, MRI, drug delivery, permanent magnets, and data storage devices. Offering interdisciplinary knowledge on the materials science of nanostructured materials and magnetics, this book will be of interest to researchers in materials science, engineering, physics and chemistry with interest in magnetic nanomaterials, as well as postgraduate students and professionals in industry and government. Provides interdisciplinary knowledge on the materials science of nanostructured materials and magnetics Aids in the

understanding of complex fundamentals and synthesis methods for magnetic nanomaterials Includes examples of real applications Shows how laboratory work on magnetic nanoparticles connects to industrial implementation and applications

Advances in Magnetic Materials: Processing, Properties, and Performance discusses recent developments of magnetic materials, including fabrication, characterization and applications in the aerospace, biomedical, and semiconductors industries. With contributions by international professionals who possess broad and varied expertise, this volume encompasses both bulk materials and thin films and coatings for magnetic applications. A

timely reference book that describes such things as ferromagnetism, nanomaterials, and Fe, ZnO, and Co-based materials, Advances in Magnetic Materials is an ideal text for students, researchers, and professionals working in materials science. Describes recent developments of magnetic materials, including fabrication, characterization, and applications Addresses a variety of industrial applications, such as aerospace, biomedical, and semiconductors Discusses bulk materials and thin films and coatings Covers ferromagnetism, nanomaterials, Fe, ZnO, and Co-based materials Contains the contributions of international professionals with broad and varied expertise Covers a holistic range of magnetic

materials in various aspects of process, properties, and performance

Magnetic nanoparticles have been attracting much interest in the fields of advanced biological and medical applications such as drug delivery, magnetic resonance imaging, and array-based assaying as well as in the fields of separation science. This book presents current research in the study of the properties, synthesis and applications of magnetic nanoparticles. Topics include the synthesis of organic based magnetic nanoparticles-polymers and calixarene based magnetic nanoparticles; ferromagnetism in carbon and boron nitride nanostructures; and computer simulations, chemical

syntheses and biomedical diagnosis using magnetic nanoparticles.

The ever-increasing desire for more energy attainable from a smaller volume of matter has driven researchers to explore advanced materials at the molecular size. Magnetic materials at the nanometer size scale have been the subject of enormous research effort worldwide for more than half a century. Different magnetic nanoparticles have shown different behavior in the absence and presence of an external magnetic field, which has led them to be categorized as soft or hard magnets. Applications range from medical and biomedical devices to magnetic recording media and magnetic sensing have emphasized

the importance of this class of materials. Soft magnetic phases have found application in power generation and magnetic targeted drug delivery, while hard magnets have been subject of extensive research for application as energy storage media. Discovery of the exchange-coupling phenomenon between two adjacent hard and soft magnetic phases has attracted scientists to develop advanced materials for energy storage with no usage of fossil fuels: clean energy. In this Dissertation, synthesis of pure phase, soft FeCo nanoparticles with high magnetic moment and hard phase CoxC nanoparticles possessing high coercivity is reported. The polyol method (chemical co-precipitating at polyhydric alcohol as reducing agent) is

used to make FeCo and CoxC nanoparticles and the effects of important reaction kinetics parameters on the structure and magnetic properties of the products are studied. Careful analysis of correlations between these parameters and the properties of the magnetic particles has made synthesis of FeCo and CoxC nanoparticles with desired properties possible. Fabrication of MnAlC-FeCo heterostructures as a rare earth-free alternative for high-performance permanent magnet is also reported. To synthesize MnAlC-FeCo, mechanical alloying and dry mixing of MnAlC and FeCo nanoparticles are accomplished followed by annealing in a furnace. Overall, the achieved results in this work enable synthesis of high

moment FeCo and high coercivity CoxC with desired structure and magnetic properties obtained through polyol method. In particular, this Dissertation provides the technique to fabricate cobalt carbide nanoparticles without using rare earth elements as a catalyst or as heterogeneous seed nuclei at any stage of the processing.

Synthesis, Physicochemical Properties and Role in Biomedicine

Applications of Nanomaterials Volume 2

Synthesis, Properties, and Applications

Fundamentals and Industrial Applications of Magnetic Nanoparticles

Nanostructures with Tunable Properties and Diverse

Applications

Fundamental Concepts, Biological Interactions and Clinical Applications

Discover an essential overview of recent advances and trends in nanoparticle catalysis Catalysis in the presence of metal nanoparticles is an important and rapidly developing research field at the frontier of homogeneous and heterogeneous catalysis. In Nanoparticles in Catalysis, accomplished chemists and authors Karine Philippot and Alain Roucoux deliver a comprehensive guide to the key aspects of nanoparticle catalysis, ranging from synthesis, activation methodology, characterization, and theoretical modeling, to application in important catalytic reactions, like hydrogen production and

biomass conversion. The book offers readers a review of modern and efficient tools for the synthesis of nanoparticles in solution or onto supports. It emphasizes the application of metal nanoparticles in important catalytic reactions and includes chapters on activation methodology and supported nanoclusters. Written by an international team of leading voices in the field, Nanoparticles in Catalysis is an indispensable resource for researchers and professionals in academia and industry alike. Readers will also benefit from the inclusion of: A thorough introduction to New Trends in the Design of Metal Nanoparticles and Derived Nanomaterials for Catalysis An exploration of Dynamic Catalysis and the Interface Between Molecular and Heterogeneous Catalysts A practical discussion of Metal Nanoparticles in Water: A Relevant Toolbox for Green

Catalysis A concise treatment of the opportunities and challenges of CO2 Hydrogenation to Oxygenated Chemicals Over Supported Nanoparticle Catalysts Perfect for catalytic, organic, inorganic, and physical chemists, Nanoparticles in Catalysis will also earn a place in the libraries of chemists working with organometallics and materials scientists seeking a one-stop resource with expert knowledge on the synthesis and characterization of nanoparticle catalysis.

A collection of highly selected, peer-reviewed chapters, this book showcases the research of an international roster of scientists. It covers nanomaterials with emphasis on synthesis, characterization, and applications. It also presents emerging developments in nanotechnology in areas as diverse as medicine, energy, electronics, and agriculture. In addition to

engineering aspects, the book discusses the physics, chemistry and biotechnology behind the fabrication and device designing. Offering the latest information in magnetic nanoparticle (MNP) research, this volume reveals the in-depth knowledge behind this highly important and emerging area of nanotechnology. Timely and comprehensive, this book presents recent advances in magnetic nanomaterials research, covering the latest developments, including the design and preparation of magnetic nanoparticles, their physical and chemical properties as well as their applications in different fields, including biomedicine, magnetic energy storage, wave-absorbing and water remediation. By allowing researchers to get to the forefront developments related to magnetic nanomaterials in various disciplines, this is invaluable reading for the nano, magnetic,

energy, medical, and environmental communities.

The Design and Synthesis of Magnetic Nanocomposites

A Study of the Structural, Microstructural and Magnetic Properties of Iron-platinum and Cobalt-platinum Type Nanoparticles

Magnetic Nanomaterials in Analytical Chemistry

Environmental and Agricultural Applications

Cobalt-based Magnetic Nanoparticles

Magnetic Nanostructures

Magnetism lies at the core of modern technology and can be found in industries such as oil refining, automotive, telecommunications, personal electronics, and power generation that

are integral to our day to day lives. This permeation into everyday life has been enhanced in the past several decades with improvements in material design based upon the principles of nanotechnology leading to smaller, faster, and more efficient devices. The presented research will discuss the synthesis and processing of multiple magnetic nanoparticle structures designed for the enhancement of various, application specific, properties. In the first experiments a tunable core/shell structure was developed with either enhanced optical

properties or enhanced catalytic reactivity based solely upon small manipulations in the synthesis resulting in alternate morphologies. Essentially reaction times were controlled to direct core nucleation followed by shell growth and based upon addition times and concentration the final product could be manipulated as either a Fe/Ag or Ag/Fe core/shell. The modifications also resulted in Fe particles decorated with Ag islands that showed significant Plasmon shifts while still maintaining their high magnetization. These particles present applications in catalysts,

sensors, and separations. Secondly FexCo100-x alloys were generated in order to determine the atomic compositions with the best magnetic properties. Several post-processing cleaning and annealing regimes were used to determine the most effective method of preparing the particles for utilization in devices. Annealing temperatures of 450° C were found most effective at enhancing magnetic properties while minimizing grain growth. Finally the synthesis of exchange-coupled hard magnetic core/shell nanoparticles was conducted. In this synthesis SmCo5 was

synthesized via solvent assisted ball milling in oleic acid. Once completed these particles were processed in a multistep cleaning process which removed excess solvent and much of the surface oxidation. The particles were then suspended in a non-aqueous solvent and a magnetically coupled Co shell was carefully grown under sub-zero conditions. The resulting composite material demonstrated greatly enhanced magnetic properties and a unique laminated structure that had been elusive in nanoparticle research. Several magnetic nanoparticles and

compositions were studied resulting in increased functionality based upon the bottom-up nanostructuring of materials. This work allows for the understanding of the effect of synthetic conditions on the control of nucleation and growth dynamics within nanoparticle synthesis and the generation of high quality functional magnetic materials.

Inorganic nanoparticles are among the most investigated objects nowadays, both in fundamental science and in various technical applications. In this book the physical properties

of nanowires formed by nanoparticles with elongated shape, i.e. rod-like or wire-like, are described. The transition in the physical properties is analyzed for nanorods and nanowires consisting of spherical and rod-like nanoparticles. The physical properties of nanowires and elongated inorganic nanoparticles are reviewed too. The optical, electrical, magnetic, mechanical and catalytic properties of nanowires consisting of semiconductors, noble and various other metals, metal oxides properties and metal alloys are

presented. The applications of nanorods and nanowires are discussed in the book.
This interdisciplinary approach to the topic brings together reviews of the physics, chemistry, fabrication and application of magnetic nanoparticles and nanostructures within a single cover. With its discussion of the basics as well as the most recent developments, and featuring many examples of practical applications, the result is both a clear and concise introduction to the topic for beginners and a guide to relevant comprehensive physical

phenomena and essential technological applications for experienced researchers.
This book describes the different methodologies for producing and synthesizing silver nanoparticles (AgNPs) of various shapes and sizes. It also provides an in-depth understanding of the new methods for characterizing and modifying the properties of AgNPs as well as their properties and applications in various fields. This book is a useful resource for a wide range of readers, including scientists, engineers, doctoral and postdoctoral fellows, and scientific

professionals working in specialized fields such as medicine, nanotechnology, spectroscopy, analytical chemistry diagnostics, and plasmonics.

Synthesis and Characterization of 5-Fu Loaded Magnetic Nanocomposite Spheres for Advanced Drug Delivery

Ion Beam Synthesis and Properties of Magnetic Nanoparticles in SiO2

Silica-coated Magnetic Nanoparticles

Recent Advances in Novel Drug Carrier Systems

Processing, Properties, and Performance

Fundamentals and Applications

The development of novel methods of probing biological interactions is critical to the advancement of biomedical science. Recent progress in the synthesis and science of nanoscale structures has engendered a renaissance in the evolution of techniques aimed at the analysis of these interactions. The use of nanomaterials provides the researcher with access to the extended quantum behaviors of these materials and the ability to intimately interact with the fundamental subunits of biology. Magnetic materials on this size scale, such

as magnetic nanoparticles (MNPs), also exhibit unique properties not available in larger structures and have likewise become of chief interest in the field of nanotechnology. Through exploitation of various synthesis techniques and parameters, the physicochemical and magnetic properties of magnetic nanoparticles can be exquisitely controlled. Magnetorelaxometry is the field of study concerned with the mechanisms of magnetic relaxation and the development of applications that capitalize upon these phenomena. The preferred instrument for the analysis of these magnetic properties is the

superconducting quantum interference device (SQUID). This work focuses on the development and chemical modification of MNPs for use with this instrument and the demonstration of novel magnetorelaxometric applications in biomedicine. The basic chemical synthesis of magnetic nanoparticles is first developed and demonstrated, after which the SQUID system and the magnetic properties of a library of synthesis products are analyzed and evaluated for use in magnetorelaxometry. An in vitro assay for sepsis diagnostics is then developed based upon the

conjugation of anti-Escherichia coli O157:H7 antibodies to magnetic nanoparticles and the magnetorelaxometric quantification of binding of these MNPs to the target pathogen in buffer, serum and blood. Next, parameters for the conjugation of insecticidic crystal proteins to MNPs are developed and optimized for an in vivo assay for the quantification of toxin binding in the gut of live Caenorhibditis elegans nematodes. Lastly, the concentration dependent effects of MNPs upon PC12 cells are evaluated; followed by the development of an antibody based in situ assay for

the detection of tubulin using the TAT peptide for entry into live cells. The results of these assays underscore the utility of magnetorelaxometry for applications in biomedicine.

Fundamentals and Industrial Applications of Magnetic Nanomaterials highlights industrial applications of magnetic nanoparticles, reviews their rapidly emerging applications, and discusses future research directions. The book emphasizes the structure-property-functionality of magnetic nanoparticles for the most relevant industry applications. After reviewing the fundamentals,

industry applications in the biomedical, pharma, environmental, cosmetics and energy industries are explored. Cross-cutting barriers to commercialization are then discussed, along with legal, health and safety implications. Finally, opportunities for enabling a more sustainable future are covered. This book is suitable for researchers and practitioners in academia and industry in materials science and engineering, chemistry and chemical engineering. Reveals fundamental concepts of magnetic nanoparticles for modern industries and perspectives Establishes routes for the utilization of magnetic

nanoparticles in commercial-scale manufacturing
Discusses opportunities for magnetic nanoparticles to help enable sustainable applications
Suspensions of both dispersed and clustered iron oxide nanoparticles are of interest for biomedical applications as diagnostic and therapeutic agents due to their bio-compatibility and interesting magnetic and magnetic resonance properties. Their application is critically dependent on the fact that these properties are highly size-dependant. By developing NP synthesis and assembly methods, to provide improved size control at the two levels of

organisation, NP suspensions with controlled emergent magnetic properties have been prepared. The first part of this thesis presents the size-controlled synthesis of magnetic nanoparticles whose surface is functionalised with a wide range of stabilising ligands. An investigation was undertaken to elucidate the effect of the stabilising ligands on the physical properties. The second part of the thesis presents a novel method for the reproducible assembly, in suspension, of NPs to form clusters. The method can be used to produce clusters of controlled size in large quantities; it is also shown

that the kinetics of assembly can be easily controlled and that this influences the emergent magnetic properties. Arising from this observation a study was undertaken to determine the role of cluster architecture on the magnetic resonance properties of their aqueous suspensions.

Recently, magnetic nanostructures have gained a remarkable interest for basic research and applied studies. Because of their low cost and ease of manufacture and modification, they have great potential for agricultural and environmental applications. The use of magnetic nanostructures

has been proven in a wide range of fields including catalysis, biotechnology, biomedicine, magnetic resonance imaging, agriculture, biosensors, and removal of environmental pollutants, among others. This book includes 16 chapters of collected knowledge, discoveries, and applications in agriculture, soil remediation, and water treatment. It describes the role of nano-agriculture with regard to food security and discusses environmental and agricultural protection concerns. It further offers potential applications of magnetic nanomaterials in the agriculture and food sectors, such as the

development of sensors, environment monitoring for wastewater treatment and the remediation of contaminated soils. Increasing crop yield through the use of nanopesticides or nanofertilizers and biosecurity using sensors for detecting pathogens along the entire food chain are discussed as well. This book also brings together various sources of expertise on different aspects magnetic nanostructure application in the agri-food sector and environment remediation. Magnetic nanostructures also have great potential in biotechnological processes, as they can be utilized as a carrier for

enzymes during different biocatalytic transformations. Novel magnetic nanomaterials can be used for detection and separation of pesticides from environmental and biological samples. The excellent adsorption capacity of the modified magnetic nanoadsorbents together with other advantages such as reusability, easy separation, environmentally friendly composition, and freedom of interferences of alkaline earth metal ions make them suitable adsorbents for removal of heavy metal ions from environmental and industrial wastes. One of the most important environmental applications of

magnetic nanostructures has been in the treatment of water, whether in the remediation of groundwater or through the magnetic separation and/or sensing of contaminants present in various aqueous systems. The integrated combination of these 16 chapters, written by experts with considerable experience in their area of research, provides a comprehensive overview on the synthesis, characterization, application, environmental processing, and agriculture of engineered magnetic nanostructures. Its comprehensive coverage discusses how nanostructure materials interact in plants as well as

their potential and useful applications.

From Fabrication to Clinical Applications

Synthesis and Characterization of Iron Based Nanoparticles for Novel Applications

Clinical Applications of Magnetic Nanoparticles

Plasma Synthesis and Self-Assembly of Magnetic Nanoparticles

Advanced Nanomaterials

An Insight into Targeted Drug Delivery and Toxicology

Offering the latest information in magnetic nanoparticle (MNP) research, this book builds upon the success of the first volume and

provides an updated and comprehensive review, from synthesis, characterization, and biofunctionalization to clinical applications of MNPs, including the diagnosis and treatment of cancers. The book captures some of emerging research area which was not available in the first volume. Good Manufacturing Practices and Commercialization of MNPs are also included. This volume, also written by some of the most qualified experts in the field, incorporates new developments in the literature, and continues to bridge the gaps between the different areas in this field.

This contribution book collects reviews and original articles from eminent experts working in the interdisciplinary arena of novel drug delivery systems and their uses. From their direct and recent experience, the readers can achieve a wide vision on the new and ongoing potentialities of different drug delivery systems. Since the

advent of analytical techniques and capabilities to measure particle sizes in nanometer ranges, there has been tremendous interest in the use of nanoparticles for more efficient methods of drug delivery. On the other hand, this reference discusses advances in the design, optimization, and adaptation of gene delivery systems for the treatment of cancer, cardiovascular, pulmonary, genetic, and infectious diseases, and considers assessment and review procedures involved in the development of gene-based pharmaceuticals.

Magnetic Nanomaterials in Analytical Chemistry provides the first comprehensive review of magnetic nanomaterials in a variety of analytical chemistry applications, including basic information necessary for students and those new to the topic to utilize them. In addition to analytical chemists, those in various other disciplines

where these materials have great potential—e.g., organic chemistry, catalysis, sensors—will also find this a valuable resource. Magnetic nanomaterials that can be controlled using external magnetic fields have opened new doors for the development of new sample preparation methods and novel magnetic sorbents for forensic chemistry, environmental monitoring, magnetic digital microfluidics, bioanalysis, and food analysis. In addition, they are seeing wide application as sensing materials in the development of giant magnetoresistive sensors, biosensors, electrochemical sensors, surface-enhanced Raman spectroscopy sensors, resonance light scattering sensors, and colorimetric sensors. Includes fundamental information on magnetic nanomaterials, including their classification, synthesis, functionalization, and characterization methods, separation and isolation techniques, toxicity, fate, and safe

disposal Each chapter describes a specific application Utilizes figures, schemes, and images for better understanding of the principles of the method Presents information on advanced methods, such as giant magnetoresistive and magnetic digital microfluidics

The work in this thesis has been focused on the fabrication and characterization of iron based nanoparticles with controlled size and morphology with the aim: (i) to investigate their properties for potential applications in MICR toners and biomedical field and (ii) to study finite size effects on the magnetic properties of the nanoparticles. For the biomedical applications, core/shell structured iron/iron-oxide and hollow shell nanoparticles were synthesized by thermal decomposition of iron organometallic compounds [Fe(CO) 5] at high temperature. Core/shell structured iron/iron-oxide

nanoparticles have been prepared in the presence of oleic acid and oleylamine. Particle size and composition was controlled by varying the reaction parameters during synthesis. The as-made particles are hydrophobic and not dispersible in water. Water dispersibility was achieved by ligand exchange a with double hydrophilic diblock copolymer. Relaxometery measurements of the transverse relaxation time T 2 of the nanoparticles solution at 3 Tesla confirm that the core/shell nanoparticles are an excellent MRI contrast agent using T 2 weighted imaging sequences. In comparison to conventionally used iron oxide nanoparticles, iron/iron-oxide core/shell nanoparticles offer four times stronger T 2 shortening effect at comparable core size due to their higher magnetization. The magnetic properties were studied as a function of particle size, composition and morphology. Hollow nanostructures are composed

of randomly oriented grains arranged together to make a shell layer and make an interesting class of materials. The hollow morphology can be used as an extra degree of freedom to control the magnetic properties. Owing to their hollow morphology, they can be used for the targeted drug delivery applications by filling the drug inside their cavity. For the magnetic toners applications, particles were synthesized by chemically reducing iron salt using sodium borohydride and then coated with polyethylene glycol. Parameters such as the reactant concentrations and their flow rate were varied to study the effect of particle size, structure and crystallinity on the magnetic nanoparticles. Many different hydrophilic surfactants and polymers electrolytes were investigated for the particles' stability in water. PSSNa was found to be the best coating agent among all the other investigated polymer and surfactants for particles stability in

water. Particles have an average size of 50 nm and magnetization above 150 emu/g. It is anticipated that owing to their high saturation magnetization and magneto crystalline anisotropy, the incorporations of PSSNa coated nanoparticles into the MICR toner can reduce the pigment loading and hence optimize the toner quality. The magnetic properties were studied as a function of particle size, composition and morphology. The saturation magnetization and coercivity was found to be strongly dependent on the particle size and morphology. The estimated effective anisotropy of the particles was found to be much higher than their bulk values because of their morphology and finite size effects. Core/shell particles below an average size of 12 nm display superparamagnetism and exchange bias phenomenon. The hollow morphology can be used as an extra degree of freedom to control

magnetic properties. The enormously large number of pinned spins at the inner and outer surface and at the interface between the grain boundaries in hollow nanoparticles, gives rise to a very large value of effective anisotropy in these nanoparticles and measured hyteresis loops are minor loops. The surface spin disorder contribution to magnetic behavior is strongly influenced by the cooling field magnitude.

Design, Synthesis and Characterization

Advanced Environmental Analysis

Structure Versus Magnetism in Magnetic Nanoparticles

Measuring and Improving the Properties of Magnetic Nanoparticles

Properties, Synthesis, Characterization, and Applications

Iron Oxide Nanoparticles for Biomedical Applications

Thesis (M.A.) from the year 2014 in the subject Chemistry - Bio-

chemistry, University of Kufa (University of Kufa), language: English, abstract: The National Nanotechnology Initiative defines nanotechnology as the manipulation of matter to at least one dimension sized from 1 to 100 nm. This definition shifted from a particular technological goal to a research category inclusive of all types of research and technologies that deal with the special properties of matter that occur below the given size threshold. These unique effects often provide nanoscale materials the desired chemical, physical, and biological properties that differ from those of their larger or bulk counterparts .

Environmental analysis techniques have advanced due to the use of nanotechnologies in improving the detection sensitivity and miniaturization of the devices in analytical procedures. These allow for developments such as increases in analyte

concentration, the removal of interfering species and improvements in the detection limits. Bridging a gap in the literature, this book uniquely brings together state-of-the-art research in the applications of novel nanomaterials to each of the classical components of environmental analysis, namely sample preparation and extraction, separation and identification by spectroscopic techniques. Special attention is paid to those approaches that are considered greener and reduce the cost of the analysis process both in terms of chemicals and time consumption. Advanced undergraduates, graduates and researchers at the forefront of environmental science and engineering will find this book a good source of information. It will also help regulators, decision makers, surveillance agencies and the organizations assessing the impact of pollutants on the

environment.

Iron Oxide Nanoparticles for Biomedical Applications: Synthesis, Functionalization and Application begins with several chapters covering the synthesis, stabilization, physico-chemical characterization and functionalization of iron oxide nanoparticles. The second part of the book outlines the various biomedical imaging applications that currently take advantage of the magnetic properties of iron oxide nanoparticles. Brief attention is given to potential iron oxide based therapies, while the final chapter covers nanocytotoxicity, which is a key concern wherever exposure to nanomaterials might occur. This comprehensive book is an essential reference for all those academics and professionals who require thorough knowledge of recent and future developments in the role of iron oxide

nanoparticles in biomedicine. Unlocks the potential of iron oxide nanoparticles to transform diagnostic imaging techniques Contains full coverage of new developments and recent research, making this essential reading for researchers and engineers alike Explains the synthesis, processing and characterization of iron oxide nanoparticles with a view to their use in biomedicine Magnetic targeted drug delivery, the science concerned with the design, characterization and use of magnetic materials as carriers of therapeutic agents presents promising advances in the study of drug delivery and pharmacokinetics. This is made possible by use of nanotechnology in the areas, such as engineering, biotechnology, chemistry and other sciences to develop new materials and mechanisms that can be channeled to improve the way diseases are identified and treated. The aim of this research

was to introduce the use of cobalt zinc ferrite nanoparticles as magnetic materials that could be formulated and used for targeted drug delivery, and compare the results with the commonly used magnetite. This study focused on the preparation, characterization, particle flow characteristics and cytotoxicity evaluation of magnetic materials. Cobalt zinc ferrite and magnetite nanoparticles (~10 nm) were synthesized by chemical co-precipitation of initial reagents. An oil-in-oil emulsion/solvent evaporation technique was used to embed the magnetic nanoparticles (MNP) plus a sample drug in a biodegradable polymer poly (DL-lactide-co-glycolide) (PLGA) to produce a magnetic nanocomposite (MNC) spheres. MNC spheres with different MNP concentrations (10%, 15%, 20%, and 25%) were prepared and characterized to determine their physical and

magnetic properties by various techniques including; X-ray diffraction, dynamic laser light scattering (DLLS), scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Mossbauer spectroscopy(MS) and superconducting quantum interference magnetometer (SQUID). The hydrodynamic flow characteristics of MNP and MNC spheres were also evaluated using experimental techniques. The cytotoxicity effects of these materials on normal cells were further determined from in-vitro cell trials. Results show that MNC spheres (200 nm to 1.1 um in diameter) retained superparamagnetic properties when embedded with Co0.5Zn0.5Fe2O4 nanoparticles, and had a blocking temperature ranging from 120K to 140K and a saturation magnetization above 2,000 Oe. The magnetic properties of the embedded Co0.5Zn0.5Fe2O4 were close to those of

magnetite. The effectiveness of these nanomaterials as carrier particles in drug delivery under various flow conditions depended on the vessel diameter, strength of magnetic field and concentration of MNP. An increase in the number of MNC captured could be achieved by increasing the MNP content, vessel diameter and magnetic field at optimal flow conditions. Cytotoxicity testing showed that the use of cobalt zinc ferrite delivery systems was viable though with some identifiable constraints when compared with magnetite. A reduction in sample concentration improved cell viability significantly making it potentially useful in drug delivery.

From Lab to Fab

Synthesis of New Magnetic Nanoparticles and Study their Effect on Prolactin Structure

Properties, Synthesis and Applications

Nanoparticles for Biomedical Applications

Physical Properties of Nanorods

Magnetic Nanoparticle-Based Hybrid Materials: Fundamentals and Applications introduces the principles, properties, and emerging applications of this important materials system. The hybridization of magnetic nanoparticles with metals, metal oxides and semiconducting nanoparticles may result in superior properties. The book reviews the most relevant hybrid materials, their mechanisms and properties. Then, the book focuses on the

rational design, controlled synthesis, advanced characterizations and in-depth understanding of structure-property relationships. The last part addresses the promising applications of hybrid nanomaterials in the real world such as in the environment, energy, medicine fields. Magnetic Nanoparticle-Based Hybrid Materials: Fundamentals and Applications comprehensively reviews both the theoretical and experimental approaches used to rapidly advance nanomaterials that could result in new technologies that impact day-to-day life and society in key areas such as health and the

environment. It is suitable for researchers and practitioners who are materials scientists and engineers, chemists or physicists in academia and R&D. Provides in-depth information on the basic principles of magnetic nanoparticles-based hybrid materials such as synthesis, characterization, properties, and magnon interactions Discusses the most relevant hybrid materials systems including integration of metals, metal oxides, polymers, carbon and more Addresses the emerging applications in medicine, the environment, energy, sensing, and computing enabled by magnetic

nanoparticles-based hybrid materials