Approach in magnetic nanoparticles for biotechnological applications

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Abstract (600 word limit)

Magnetic nanoparticles provide abundant attractive prospects in biotechnology. First, they need sizes that place them at dimensions comparable to those of a virus (20–500 nm), a protein (5–50 nm) or a gene (2 nm wide and 10–100 nm long). Second, the nanoparticles are magnetic, which suggests that they obey Coulomb's law, and can be manipulated by an external magnetic field gradient. Third and eventually, nanoparticles have an outsized surface that may be properly modified to attach biological agents.

Applications in biotechnology impose strict requirements on the particles' physical, chemical and pharmacological properties, together with chemical composition, granulometric uniformity, crystal structure, magnetic behavior, surface structure, adsorption properties, solubility and low own toxicity. As an example, in order for magnetic drug-targeting to be safe and effective (with the minimum amount of magnetic particles, a most of drug should be simply administered and transported to a particular site), the subsequent parameters of the nanomagnets are critical: particle size (small as possible to boost tissular diffusion, and to have possess sedimentation times and high effective surface areas), surface characteristics (easy encapsulation of the magnetic nanoparticles protects them from degradation and endows biocompatibility), and smart magnetic response (possibility of decreasing nanomagnets concentration in blood and thus diminishing the associated side effects). On the other hand, magnetically active particles applicable in separation processes (in vitro applications) ought to stable units composed of a high concentration of superparamagnetic nanoparticles, with every of the huge entities monodisperse in size and uniform in magnetic particle concentration.

The major difficulty within the synthesis of ultrafine particles is to manage the particle size at the nanometric scale. This difficulty arises as a results of the high surface energy of these systems. The interfacial tension acts as the driving force for spontaneously reducing the expanse by growing throughout the initial steps of the precipitation (nucleation and growth), and through aging (Ostwald ripening). Therefore, the search for facile and flexible synthetic routes able to manufacture magnetic nanoparticles with the required size and acceptable size distribution while not particle aggregation is of very extremely importance to comprehend the full potential of these materials in biomedicine.

Herein we tend to create a quick revision of some of the most frequently used synthetic routes for the preparation of magnetic nanoparticles and the way the particles made by these methods have been recently used in biotechnology for a series of applications like separation, detection and magnetic resonance imaging.

Synthesis in solution

Wet chemical methods have been widely used to manufacture nanostructured materials because of their straightforward nature and their potential to supply massive quantities of the final product.

Synthesis by aerosol/vapor methods

Spray and laser pyrolysis are shown to be wonderful techniques for the direct and continuous production of well-defined magnetic nanoparticles under exhaustive control of the experimental conditions.

Spray pyrolysis is a process during which a solid is obtained by spraying a solution into a series of reactors wherever the aerosol droplets undergo evaporation of the solvent and solute condensation inside the droplet, followed by drying and thermolysing of the precipitated particle.

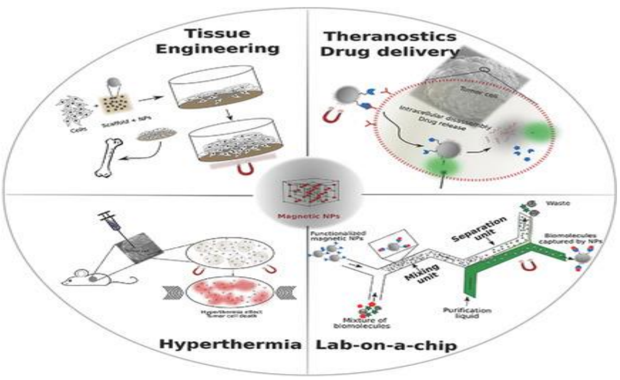
Magnetotactic bacteria

Even though this subject cannot strictly be thought of as a conventional synthetic route, we tend to here create a quick outline of the use of magnetotactic bacteria in the biotechnology field. Excellent reviews on the use of magnetotactic bacteria in this field.

In 1975, Blakemore discovered magnetotactic bacteria. Magnetotactic bacteria type a heterogeneous group of Gram-negative prokaryotes with morphological and habitat diversity.

In the past few years, respectable progress has been created within the synthesis of monodisperse magnetic nanoparticles. The outlook of such magnetic nanoparticles for their use in biotechnology is extremely promising. One area of special interest is that the development of strategies able to increase the circulation time of magnetic nanoparticles within the blood. Integration of magnetic nanoparticles in stealth liposomes or artificial hollow capsules appears a promising approach to resolve this problem.

Image



Importance of Research (200 word limit)

With the progress of nanotechnology and molecular biology, nanoparticles are wide studied and applied in biomedicine. Significantly, characterized by distinctive magnetic property, targeting, and biocompatibility, magnetic nanoparticles become one among the research hotspots within the nanomedical field. Herein, we have a tendency to summarized the recent advances of magnetic nanoparticles in medicine, together with the property, carrier function, MRI, and tumor magnetic inductive hyperthermia of magnetic nanoparticles. The stable development of medicine has rendered early diagnosis and precise treatment of its development direction. Nanotechnology has provided a latest platform for medicine development. With the development of nanoscience and nanotechnology, the research and application of magnetic NPs have created hefty progress within the biomedical field. For instance, magnetic NPs are extensively applied in biomolecule vectors, targeted localization, MRI, and thermotherapy. However, most studies stay at the laboratory research stage, and few have extremely been applied in clinics. Their toxicity, side effects, long-term efficacy, and in vivo metabolic mechanism still ought to be additional studied. A huge amount of basic and clinical research must be done for their clinical application. Confidently, magnetic NPs can have a broad application prospect within the medical field, with the increasing development and the therefore the intensive research of nanotechnology, biotechnology, and medicine.

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Biography (200 word limit)

C.J..Morales from Instituto de Ciencia de Materiales de Madrid, Campus de Cantoblanco, 28049 Faculty of Biological Sciences Madrid, Spain expertise in evaluation and passion in improving the health and wellbeing. She lives in Spain, with her husband and their two children. She is recognized internationally as a leader in the field of nutritional influences in neurological disorders. She is known as foremost authority in applying behavior science to marketing to solve their most important behavior challenges.. Her open and contextual evaluation model based on responsive constructivists creates new pathways for improving healthcare. She has built this model after years of experience in research, evaluation, teaching and administration both in hospital and education and biotechnological institutions. She published article entitled "Approach in magnetic nanoparticles for biotechnological applications" in many countries and won the research award. She worked for eleven years as a writer and editor at the national journal. The foundation is based on fourth generation evaluation (Guba& Lincoln, 1989) which is a methodology that utilizes the previous generations of evaluation: measurement, description and judgment. He has contributed extensively to the world medical literature with publications. It allows for value-pluralism. This approach is responsive to all stakeholders and has a different way of focusing on latest biotechnological applications for nanotechnology particles.

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Information of Institute and laboratory (200 word limit)

Instituto de Ciencia de Materiales de Madrid, Campus de Cantoblanco, 28049 Faculty of Biological Sciences Madrid, Spain. The mission is to generate new fundamental and applied knowledge on materials and processes with added value, and their transfer to the productive sectors at the local, national and European scales. We are involved in the training of new professionals on materials research, and in the dissemination of the scientific knowledge. The Laboratory for Characterization and Growth of Thin Films has the following equipment and services:Surface profilometer Dektak 150, from Veeco. Portable Raman Analyzers EZ-Raman-N from Enwave Optronics, coupled to an optical microscope Leica DM300 with Nd:YAG (532 nm) laser. Emissometer Model AE1 from Devices & Service Company.Spectrophotometer SolidSpec 3700 UV-VIS-NIR from Shimadzu with Integrating Sphere, Wavelenght range: 190nm-3300nm. FTIR spectroscopy (near-specular reflectance), Varian 660 MID-NEAR IR, with variable incident-angle accessory. Nanoindenter, mod. NanoTest P1, from MicroMaterials, up to 500mN and Berkovich indenter. (100nm). Thin films deposition systems: (i) Sputtering with up to 3 magnetron sources simultaneously for deposition of metals, oxides and nitrides (ii) Nitrogen (or noble gases) Ion beam-assisted thermal evaporation (with two electron guns). Low-pressure annealing at controlled atmosphere. Tubular quartz reactor. Temperatures up to 900°C and Ar, N2 and/or O2 atmosphere. Nuclear Magnetic Resonance Laboratory has NMR Spectrometer AVANCE II (BRUKER), 9.4 Tesla magnet.MAS probes for different spinning speeds for the study of a wide range of nuclei

Recent Publications (15 to 20)

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4. N.D. Chasteen et al. J. Struct. Biol (1999) Alcohol and public health. Lancet 365: 519-530.
5. 5. V. Pillai et al. Adv. Colloid Interface Sci.(1995) Neuroinflammation as a neurotoxic mechanism in alcoholism: Commentary on "Increased MCP- 1 and microglia in various regions of human alcoholic brain". Experimental neurology 213:10-17.
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11. P. Tartaj P. Tartaj et al. J. Phys. DAppl. Phys.(2003) Processing of Iron Oxide Nanoparticles by Supercritical Fluids 599–614
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14. R. Massart IEEE Trans. Magn. Magn. (1981) Preparation and properties of monodisperse magnetic fluids 1-5
15. J.P. Jolivet F. Taran et al. Angew. Chem. Int. Ed. (2002) Immunologically driven chemical engineering of antibodies for catalytic activity 81-98

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