IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

USAGE OF NANOPARTICLES IN FUTURE GENERATION

Kokila Sivasangaran, A.M.Thafshila Aafin, R.Anuradha *

PG and Research Department of Biochemistry, Sengamala Thaayar Educational Trust Women's College, Mannargudi - 614016.

ABSTRACT

Nanotechnology has a significant role to play in international sustainability initiatives. We look at how nanotechnology's existing and future capabilities match with and assist the international Sustainable Development Goals. We propose that as a field, we can accelerate progress toward these goals both directly and indirectly through technical solutions and our unique multidisciplinary talents in communication and problem-solving. Targeting solutions, technological translation, the circular economy, and several examples from national initiatives around the world in achieving these aims are all discussed. Nanotechnology has a wide range of applications in many areas of life, and it helps to progress many scientific and industrial fields, including information technology, energy, medicine, national security, environmental science, food safety, and many more. Nanotechnology's rapid advancement in every industry will undoubtedly enable the next generation to solve all of life's difficulties.

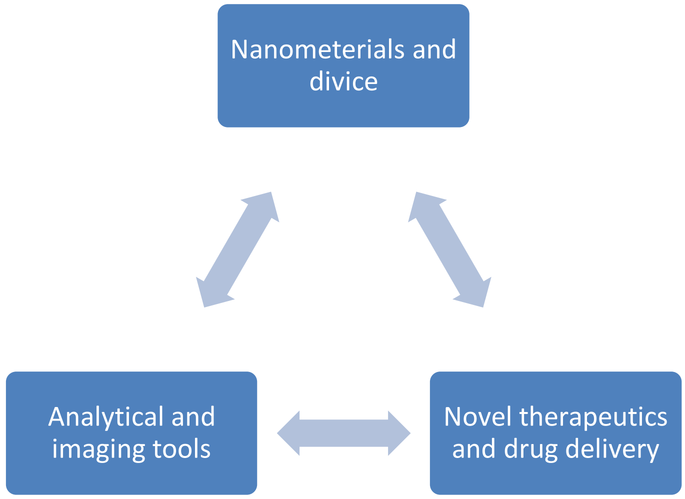
Key words: Nanotechnology, medicine, agriculture, cosmetics, military.

Introduction

One of the most promising essential enabling technologies of the twenty-first century is nanotechnology. The research and application in this sector are approaching 50 years. It is a rapidly increasing field of study that contributes to practically every branch of science, including natural sciences and engineering, materials science, medicine, agriculture, and information and communication technology to name a few. As society faces major if not grave difficulties, we look to new technologies for solutions in practically every area, including health, energy, climate, and the environment, either directly or indirectly.

Nanotechnology's future impact on medicine

The science and technology of diagnosing, treating, and preventing disease and traumatic injury, as well as relieving pain and preserving and improving human health, using nanoscale structured materials biotechnology, and genetic engineering, and eventually complex machine systems and nanorobots, is referred to as "Nanomedicine." Nanotechnology in healthcare now faces several challenges. More research is needed on nanotechnology's long-term effects and environmental implications. Authorities need to establish clearer criteria for nanotech-based gadgets and their possible health dangers. Nanotechnology-based gadgets are frequently expensive, which makes bulk production difficult. The adoption of this technology will be aided by the availability of low-cost manufacturing options for these devices.



The use of nanodevices for early illness detection or predisposition at the cellular and molecular level is known as nanodiagnostics. By utilizing selected nanodevices to perform various analyses at the subcellular scale, nanomedicine could improve the efficiency and reliability of in-vitro diagnostics using human fluids or tissues samples. Nanomedicine could build devices that work inside the human body to detect sickness early on, identify and measure harmful chemicals, and tumor cells in in vivo diagnostics. Regenerative medicine is a new multidisciplinary discipline that uses cell treatment and tissue engineering to explore for ways to repair, enhance, and maintain cells, tissues, and organs. It is possible to interact with cell components, influence cell proliferation, and differentiation, as well as the formation and structure of the extracellular matrix, using nanotechnology. Nanorobotic microbivores - Artificial phagocytes known as microbivores might patrol the bloodstream, searching for and digesting pathogens such as bacteria, viruses, and fungi. Even the most serious septicemic diseases would be cleared by microbivores in hours or less.. Surgical nanorobotics - When injected into the body by the circulatory system or cavities, a surgical nanorobot programmed or led by a human surgeon might function as a semiautonomous on-site surgeon. An onboard computer may control the gadget, which could search for pathology and then diagnose and treat lesions using nanomanipulation while keeping touch with the supervising surgeon via coded ultrasound signals. Nanogenerators - By converting mechanical energy from bodily movement, muscle stretching, or water flow into electricity, they could create a new generation of self-powered implantable medical devices, sensors, and portable electronics. Nanogenerators generate electricity by bending and then releasing piezoelectric and semiconducting zinc oxide nanowires. Nanowires may be produced on polymer-based films, and the utilization of flexible polymer substrates may one day allow portable gadgets to be powered by their users' movement. Nanodentistry - Using nanomaterials, biotechnology, including tissue engineering, and, eventually, dental nanorobotics, nano dentistry will enable the preservation of comprehensive oral health. Local anesthesia, dentition renaturalization, permanent hypersensitivity cure, complete orthodontic realignments in a single office visit, covalently bonded diamondized enamel, and continuous oral health maintenance using mechanical dentifrobots are some of the new potential treatment options in dentistry. Tooth repair - Orthodontic nanorobots could control periodontal tissues directly, allowing for painless tooth straightening, rotation, and vertical repositioning in minutes to hours. Replacement of upper enamel layers with covalently bonded artificial materials such as sapphire or diamond, which have 20–100 times the hardness and failure strength of natural enamel, or current ceramic veneers with good biocompatibility, can improve tooth durability and beauty.

The impact of nanotechnology on agriculture

Nanotechnology is used in agriculture in a variety of ways including nano pesticides delivery. Nanoparticles containing biofertilizers are released slowly and in a controlled manner. Genetic resources for crop development are transported. Futuristic Strategies and Policy Options for Sustainable Farming Using Agricultural Nanotechnology Controlled green nanoparticle synthesis, Understanding root endophytes, and mycorrhizal fungi nanoparticles, which have a vital role in plant production and disease management Interaction of nanoparticles with plant systems, such as nanoparticle transport mechanisms within the plant body. Nano biosensors are being used to detect phytopathogens and other biotic and abiotic stressors quickly. Nanobiosensors for quick analysis of soil, plants, water and pesticides are being developed in a portable and user-friendly manner.

Nanotechnologies hold the key to the future of food

The food chain and consumers should be at the center of the future of new food systems. Nanotechnology will give several solutions in the food chain, including raw material production, processing, and packaging. Similarly, nanotechnology will play a role in consumer health and gut function, as well as sensory perception and pleasure at the mouth and brain level. Five of the most important solutions for both axes are provided and analyzed in the following sections, all of which are based on nanotechnologies. Nanostructure of food - Foods' distinctive qualities stemmed not just from their chemical content but also their micro and nanostructure. The qualities and technological aptitude of foods are determined by the occurrence in nature of a particular structure at the nanoscale of food constituents (mostly polymers: proteins, carbohydrates, and lipids). There are various advantages of adopting nanostructured devices to boost the efficiency and selectivity of food processing processes. they can be employed to improve efficiency and stability and then reused to lower process costs. Nanoencapsulation can also be used to hide off-flavors or enhance the color of meals during processing. Encapsulation of polyunsaturated fatty acids is one example of how rancidity might be avoided during processing or cooking. By boosting the stability and bioavailability of bioactive food ingredients. Degradation of labile chemicals such as vitamins and antioxidants can be reduced by adopting nanoencapsulation methods. These technologies can also be utilized to supply functional chemicals on-demand to customers' health needs, increasing bioavailability by improving absorption in the human stomach through a regulated release pattern. Probably the most well accepted and widely used application of nanotechnology in the food industry is the packaging. This is due to obvious benefits such as improved material qualities (barrier, mechanical, and light materials) and their usage in the creation of active and intelligent packaging systems. Food packaging is by far the most developed field of nanotechnology application in foods, with numerous companies now selling nanotechnology-based goods.

Nanotechnology will benefit cosmetics products in future

When certain components are combined in micrometer-sized particles, which are much larger than nanosized particles, the outcome can be an undesirable product from an aesthetic standpoint. Avobenzone, for example, is a frequent ingredient in broad-spectrum sunscreens that protect the skin from both UVA and UVB radiation. However, when applied to the skin, avobenzone can make sunscreen oily and visible. Because titanium, another prominent sunscreen element, must breakdown in an oily combination, a white residue may appear on the skin after application. When these active components in sunscreens are transformed into nanoparticles, however, they can be suspended in less oily formulations that appear to vanish on the skin and leave no trace while still blocking UVA and UVB rays. Consumers may be more tempted to utilize nanoparticle-based sunscreen formulations regularly since they are more visually appealing and appear to vanish when applied." Nanotechnology is also attracting interest due to its potential application in anti-aging goods. Nanomaterials may be able to topically distribute retinoids, antioxidants, and medications such as botulinum toxin or growth factors for skin rejuvenation in the future if they are appropriately developed. Nanotechnology may allow active substances that would not ordinarily penetrate the skin to be supplied to it in anti-aging solutions. Vitamin C for example, is an antioxidant that works best beneath the top layer of skin to help combat age-related skin damage. Vitamin C is unstable in mass and has a tough time penetrating the skin.

Nanotechnology, on the other hand, may improve the stability of vitamin C and its capacity to penetrate the skin in future formulations.

Nano – Textiles: The future's fabric

The Metallics, holographic accents, and textures are likely to come to mind when you think about futuristic apparel. As indicated by certain recent runway trends, the sci-fi imagery that comes to mind is making a comeback. While we can't predict what the fashion of the future will look like, many of us anticipate that clothes in a few years will have a significantly improved function, thanks to advances in science that will allow for the creation of acleaner, safer textiles. Nanotechnology can help achieve these aims by killing bacteria and removing dirt. Beyond antibacterial nanoparticles, the field of nano-fabrics has a lot more new technologies to offer. Self-cleaning fabrics, water-repellent textiles, and clothing that may eliminate odors by chemically altering the chemicals that create foul odor are some of the other desirable clothing attributes that could be achieved with nanotechnology. The field of nano fabrics is still in its infancy and it faces a slew of challenges. Nanoparticles are discharged into wastewater when antimicrobial silver-containing clothing is laundered, giving them a limited effective lifetime when the nanomaterial washes out, because metal nanoparticles can disintegrate into harmful ions when exposed to environmental conditions. Nano fabric technologies that are newer may have their own set of difficulties that have yet to be well researched. On the other hand, the prospective benefits of nano-enhanced fabrics make their use justifiable. With continued technical innovation that allows us to address environmental concerns the field of nanotechnology will only grow.

Sensors everywhere

These sensors rely on recently developed nanomaterials and manufacturing techniques to make them smaller, more sophisticated, and energy-efficient. Sensors with extremely fine features, for example, may now be printed in large quantities on low-cost flexible plastic rolls. This opens up the possibility of placing sensors in various areas throughout the critical infrastructure to check that everything is running smoothly. Bridges, airplanes, and even nuclear power plants may benefit from this technology.

Self – Healing structures

If cracks do develop, nanotechnology may be able to assist. Changing the structure of materials at the nanoscale can give them incredible qualities, such as giving them a water-repellent texture. Materials that have been damaged or worn may one day be able to "repair" themselves thanks to nanotechnology coatings or additions. Nanoparticles dispersed throughout a material for example, can move to fill in any cracks that arise. This could lead to self-healing materials for everything from airplane cockpits to microelectronics, avoiding minor fractures from becoming larger, more dangerous flaws.

Big data made possible by Nanotechnology

All of these sensors will generate far more data than we've ever seen before, necessitating the development of technology to interpret it and identify patterns that will alert us to potential hazards. The same will be true whether we want to use "big data" from traffic sensors to help manage congestion and prevent accidents, or if we want to reduce crime by better allocating police resources using statistics. Nanotechnology is assisting in the development of ultra-dense memory that will allow us to store this vast amount of data. However, it is also serving as a source of inspiration for ultra-efficient algorithms for processing, encrypting, and transferring data without jeopardizing its integrity.

Nanoelectronics

We need new ways to generate and use electricity to combat climate change, and nanotechnology is already playing a role. It has aided in the development of batteries capable of storing more energy for electric vehicles, as well as solar panels that can convert more sunshine into power. The use of nanotexturing or nanomaterials (for example, nanowires or carbon nanotubes) to change a flat surface into a three-dimensional one with a substantially larger surface area is a frequent method in both applications. This means that the processes that enable energy storage or generation can take occur in larger space, allowing the devices to work more efficiently. Nanotechnology may one day allow items to harvest energy from their surroundings.

Nanotechnology with potential military applications

The downsizing of devices and the varied functionality that can be combined inside a single system are the most essential aspects of nanotechnology-enabled goods. As a result, the future's most significant applications will be realized for the warfighter. Whether it's a battle suit integrated with sensors for nuclear, biological, and chemical (NBC) weapons protection, bullet injuries, and monitoring of vital body parameters, nanotechnology will find applications in camouflage and concealment, weapons, communication, and situational awareness on the battlefield.

Influence of nanotechnology for society

Science and technology are the primary drivers of economic growth and improved quality of life in the economy. Research, particularly nanomaterials research, has a wide impact in health, information, energy, and many other domains where the commercialization of new technology has a significant economic advantage.

Conclustion

This review provided an in-depth look at recent nanotechnology trends that could be applied to next-generation nanotechnology. Many of the present technologies are being replaced by highly efficient and environmentally friendly nanotechnologies that match the desired goals, guidelines, and sustainability principles of green chemistry and green engineering. Nanotechnology-based on jute provides a critical platform for the long-term manufacturing of environmentally preferable, recyclable, and renewable raw materials for the manufacture of products and goods that suit people's requirements. Nanotechnology would improve the industry's ability to produce new high-performance consumer goods sustainably made of jute. We believe that by producing the next generation of nanomaterials, jute will improve people's quality of life.

REFERENCE

R. P. Feynman, Eng. Sci. 1960, 23, 22–36.

Y. Chen, Z. Lai, X. Zhang, Z. Fan, Q. He, C. Tan, H. Zhang, Nat. Rev. Chem. 2020, 4, 243–256.

Z. Zhang, Y. Ouyang, Y. Cheng, J. Chen, N. Li, G. Zhang, Phys. Rep. 2020, 860, 1–26.

Capek in Nanocomposite Structures and Dispersions, 1st ed., Vol. 23, Elsevier, 2006, pp. 1–69.

I. A. Buliyaminu, M. A. Aziz, S. S. Shah, A. K. Mohamedkhair, Z. H. Yamani, Arab. J. Chem. 2020, 13, 4785–4796.

A. J. S. Ahammad, N. Odhikari, S. S. Shah, M. M. Hasan, T. Islam, P. R. Pal, M. A. Ahmed Qasem, M. A. Aziz, Nanoscale Adv. 2019, 1, 613–626.

S. S. Shah, M. A. Alfasane, I. A. Bakare, M. A. Aziz, Z. H. Yamani, J. Energy Storage 2020, 30, 101562. [8] T. Islam, M. M. Hasan, S. S. Shah, M. R. Karim, F. S. AlMubaddel, M. H. Zahir, M. A. Dar, M. D. Hossain, M. A. Aziz, A. J. S. Ahammad, J. Energy Storage 2020, 32, 101908.

M. Ashraf, I. Khan, M. Usman, A. Khan, S. S. Shah, A. Z. Khan, K. Saeed, M. Yaseen, M. F. Ehsan, M. N. Tahir, N. Ullah, Chem. Res. Toxicol. 2020, 33, 1292–1311.

A. K. Mohamedkhair, M. A. Aziz, S. S. Shah, M. N. Shaikh, A. K. Jamil, M. A. A. Qasem, I. A. Buliyaminu, Z. H. Yamani, Arab. J. Chem. 2020, 13, 6161–6173.

N. C. Deb Nath, S. S. Shah, M. A. A. Qasem, M. H. Zahir, M. A. Aziz, ChemistrySelect 2019, 4, 9079–9083.

S. S. Shah, M. A. Aziz, Bangladesh J. Plant Taxon. 2020, 27, 467–478.

A. J. S. Ahammad, P. R. Pal, S. S. Shah, T. Islam, M. Mahedi Hasan, M. A. A. Qasem, N. Odhikari, S. Sarker, D. M. Kim, M. Abdul Aziz, J. Electroanal. Chem. 2019, 832, 368–379.

C. K. Roy, S. S. Shah, A. H. Reaz, S. Sultana, A.-N. Chowdhury, S. H. Firoz, M. H. Zahir, M. A. A. Qasem, M. A. Aziz, Chem. Asian J. 2021, 16, 296–308.

K. Hayat, S. S. Shah, S. Ali, S. K. Shah, Y. Iqbal, M. A. Aziz, J. Mater. Sci. - Mater. Electron. 2020, 31, 15859–15874.

W. Chen, H. Yu, S.-Y. Lee, T. Wei, J. Li, Z. Fan, Chem. Soc. Rev. 2018, 47, 2837–2872.

Hatami, A.; Heydarinasab, A.; Akbarzadehkhiyavi, A.; Pajoum Shariati, F. An Introduction to Nanotechnology and Drug Delivery. Chem. Methodol. 2021, 5, 153–165.

Rizvi, S.A.; Saleh, A.M. Applications of nanoparticle systems in drug delivery technology. Saudi Pharm. J. 2018, 26, 64–70.

Sahu, A.N. Nanotechnology in herbal medicines and cosmetics. Int. J. Res. Ayurveda Pharm. 2013, 4, 472–474.

Roco, M.C. National nanotechnology initiative-past, present, future. Handb. Nanosci. Eng. Technol. 2007, 2, 39.

Subramani, K.; Ahmed, W. Emerging Nanotechnologies in Dentistry; William Andrew: Norwich, NY, USA, 2017.

Khan, A.U.; Khan, M.; Cho, M.H.; Khan, M.M. Selected nanotechnologies and nanostructures for drug delivery, nanomedicine and cure. Bioprocess Biosyst. Eng. 2020, 43, 1339–1357.

Gagliardi, A.; Giuliano, E.; Eeda, V.; Fresta, M.; Bulotta, S.; Awasthi, V.; Cosco, D. Biodegradable polymeric nanoparticles for drug delivery to solid tumors. Front. Pharmacol. 2021, 12, 601626.

Shiku, H.; Wang, L.; Ikuta, Y.; Okugawa, T.; Schmitt, M.; Gu, X.; Akiyoshi, K.; Sunamoto, J.; Nakamura, H. Development of a cancer vaccine: Peptides, proteins, and DNA. Cancer Chemother. Pharmacol. 2000, 46, S77–S82.

Saul, J.M.; Annapragada, A.V.; Bellamkonda, R.V. A dual-ligand approach for enhancing targeting selectivity of therapeutic nanocarriers. J. Control. Release 2006, 114, 277–287.

Prajnamitra, R.P.; Chen, H.-C.; Lin, C.-J.; Chen, L.-L.; Hsieh, P.C.-H. Nanotechnology approaches in tackling cardiovascular diseases. Molecules 2019, 24, 2017.

Ali, S.; Khan, I.; Khan, S.A.; Sohail, M.; Ahmed, R.; ur Rehman, A.; Ansari, M.S.; Morsy, M.A. Electrocatalytic performance of Ni@ Pt core–shell nanoparticles supported on carbon nanotubes for methanol oxidation reaction. J. Electroanal. Chem. 2017, 795, 17–25.

Thomas, S.C.; Kumar Mishra, P.; Talegaonkar, S. Ceramic nanoparticles: Fabrication methods and applications in drug delivery. Curr. Pharm. Des. 2015, 21, 6165–6188.

So, W.C.; Kita, S.; Goldin-Meadow, S. Using the hands to identify who does what to whom: Gesture and speech go hand-in-hand. Cogn. Sci. 2009, 33, 115–125.

Dreaden, E.C.; Alkilany, A.M.; Huang, X.; Murphy, C.J.; El-Sayed, M.A. The golden age: Gold nanoparticles for biomedicine. Chem. Soc. Rev. 2012, 41, 2740–2779.

Khan, I.; Saeed, K.; Khan, I. Nanoparticles: Properties, applications and toxicities. Arab. J. Chem. 2019, 12, 908–931.

Vickers, N.J. Animal communication: When i'm calling you, will you answer too? Curr. Biol. 2017, 27, R713–R715.

Laurent, S.; Forge, D.; Port, M.; Roch, A.; Robic, C.; Vander Elst, L.; Muller, R.N. Magnetic iron oxide nanoparticles: Synthesis, stabilization, vectorization, physicochemical characterizations, and biological applications. Chem. Rev. 2008, 108, 2064–2110.

Zhao, B.; Hu, H.; Mandal, S.K.; Haddon, R.C. A bone mimic based on the self-assembly of hydroxyapatite on chemically functionalized single-walled carbon nanotubes. Chem. Mater. 2005, 17, 3235–3241.

Dey, P.; Das, N. Carbon Nanotubes: It's role in modern health care. Int. J. Pharm. Pharm. Sci 2013, 5, 9–13.

Kesharwani, P.; Jain, K.; Jain, N.K. Dendrimer as nanocarrier for drug delivery. Prog. Polym. Sci. 2014, 39, 268–307.

Kannan, R.; Nance, E.; Kannan, S.; Tomalia, D.A. Emerging concepts in dendrimer-based nanomedicine: From design principles to clinical applications. J. Intern. Med. 2014, 276, 579–617.

Tolia, G.T.; Choi, H.H. The role of dendrimers in topical drug delivery. Pharm. Technol. 2008, 32, 88–98.

Semwal, R.; Semwal, D.; Madan, A.; Paul, P.; Mujaffer, F.; Badoni, R. Dendrimers: A novel approach for drug targeting. J. Pharm. Res. 2010, 3, 2238–2247.

Kalomiraki, M.; Thermos, K.; Chaniotakis, N.A. Dendrimers as tunable vectors of drug delivery systems and biomedical and ocular applications. Int. J. Nanomed. 2016, 11, 1–12.

Madaan, K.; Kumar, S.; Poonia, N.; Lather, V.; Pandita, D. Dendrimers in drug delivery and targeting: Drug-dendrimer interactions and toxicity issues. J. Pharm. Bioallied Sci. 2014, 6, 139–150.

Pillai, O.; Panchagnula, R. Polymers in drug delivery. Curr. Opin. Chem. Biol. 2001, 5, 447–451.

D'Emanuele, A.; Attwood, D. Dendrimer–drug interactions. Adv. Drug Deliv. Rev. 2005, 57, 2147–2162.

Twibanire, J.-d.A.K.; Grindley, T.B. Efficient and controllably selective preparation of esters using uronium-based coupling agents. Org. Lett. 2011, 13, 2988–2991.

Aulenta, F.; Hayes, W.; Rannard, S. Dendrimers: A new class of nanoscopic containers and delivery devices. Eur. Polym. J. 2003, 39, 1741–1771.

Chaudhary, A.; Welch, J.O.; Jackman, R.B. Electrical properties of monodispersed detonation nanodiamonds. Appl. Phys. Lett. 2010, 96, 242903.

Chauhan, S.; Jain, N.; Nagaich, U. Nanodiamonds with powerful ability for drug delivery and biomedical applications: Recent updates on in vivo study and patents. J. Pharm. Anal. 2020, 10, 1–12.

Slocombe, D.; Porch, A.; Bustarret, E.; Williams, O.A. Microwave properties of nanodiamond particles. Appl. Phys. Lett. 2013, 102, 244102.

Krueger, A. New carbon materials: Biological applications of functionalized nanodiamond materials. Chem. A Eur. J. 2008, 14, 1382–1390.

Chung, E.J.; Leon, L.; Rinaldi, C. Nanoparticles for Biomedical Applications: Fundamental Concepts, Biological Interactions and Clinical Applications; Elsevier: Amsterdam, The Netherlands, 2019.

Skwarczynski, M.; Toth, I. Micro- and Nanotechnology in Vaccine Development; William Andrew: Norwich, NY, USA, 2016.

Lvov, Y.; Ariga, K.; Ichinose, I.; Kunitake, T. Assembly of multicomponent protein films by means of electrostatic layer-by-layer adsorption. J. Am. Chem. Soc. 1995, 117, 6117–6123.

J. Gao, B. Xu, B, Applications of nanomaterials inside cells, Nano Today 4 (2009) 37–51.

S. McClean, E. Prosser, E. Meehan, D. O'Malley, N. Clarke, Z. Ramtoola, D. Brayden, Binding and uptake of biodegradable poly-DL-lactide micro-and nanoparticles in intestinal epithelia, Eur. J. Pharm. Sci. 6 (1998) 153–163.

R.C. Oppenheim, Solid colloidal drug delivery systems: nanoparticles, Int. J. Pharm. 8 (1981) 217–234.