



## Nanotechnology: A new approach in pharmaceuticals

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Nanotechnology has changed our lives dramatically and influenced every sector of the research, engineering and also business community. Nanotechnology is a rapidly growing science of producing and utilizing nano-sized particles, that measure in nanometer. In other words, nanotechnology is the art of characterizing, manipulating and organizing matter systemically, at the nanometer scale, which has created a revolution in science, engineering, technology, drug delivery and therapeutics. The size of typical accessible structures is in the sub-micrometer range, being within the limits of optical resolution and barely visible with a light microscope. This scale is about 1/1000 smaller than structures that could be resolved by the naked eye, but still 1000 times larger than an atom. Recent developments are addressing the size range below these dimensions and because a typical structure size is in the nanometer range, the methods and techniques are defined as nanotechnology.

There is an argue that nanotechnology in pharmaceuticals is simply a new version of colloid science, but nanotechnology is clearly not a miniaturized version of the well colloidal drug delivery systems, such as microemulsions, emulsions and liposomes. Rather, nano-sized systems could be designed into a more sophisticated system associated with its physical dimension of less than 100 nm. Nanotechnology, as a novel technology, offers opportunities for the production of new generation of sophisticated drug delivery systems. There are now a wide range of nano-systems, not only nanoparticles and nanocapsules but lipid complexes, polymeric micelles, etc. In this regard, professor Florence believes that nanotechnology of course is much more than the nanoparticles themselves and it is indeed the growth of technologies based on such small-scale systems. He also mentions that what makes nanotechnology a new and exciting subject is the ability not only to manipulate nanoparticles and nanosystems, but also the new techniques available to measure and indeed visualize materials in the nanometer size range. Particles produced through nanotechnology are small and since the particle size is crucial, the maintenance of particle size is therefore of great importance. For instance, nano-sized particles possess very high surface to volume ratios and therefore, this property causes an interaction between the surface and mucus layer to occur. On the other hand, due to the huge surface area, surface properties of particles play an important role in protecting the active agents from degradation.

In recent years, we have been faced with an explosion in the design, development and characterization of novel nanofabricated devices for drug delivery. Professor Rytting, in his recent editorial in the *International Journal of Pharmaceutics*, has specified the various areas in which nanotechnology is being used, as follows:

- drug discovery (including combinatorial chemistry and synthesis on the molecular and macromolecular scale),
- nanoanalysis including bioanalysis using miniaturized probes, microarrays and lab-on-a-chip approaches,
- utilizing approaches used by the body in fluid flow and targeting,
- drug delivery systems having sizes in the nanometer range (e.g. liposomes, nanoparticles, micro-emulsions, dendrimers, etc.),

- implantable devices that can sense blood levels and automatically administer drugs,
- nanoscale biomaterials including biomimetics,
- biological macromolecules (e.g. proteins, enzymes, DNA and RNA based nanostructures, molecular assemblies, biomolecules, cells, biochips, etc.),
- molecular sensors and biosensors, as well as clinical diagnostic techniques,
- gene delivery and expression.

Aspects of nanotechnology have been utilized by pharmaceutical scientists for many years in drug product formulation and delivery, leading to the development of nanoparticulate systems and it is conceivable that the tomorrow's nanotechnology products will have the same impact on our daily lives, as the invention of other technologies.

- (1) Lee HL. Nanotechnology: challenging the limit of creativity in targeted drug delivery. *Adv. Drug Deliver. Rev.* (2004) 56: 1527 - 1528.
- (2) Rytting H. Pharmaceutical nanotechnology: a new section in IJP. *Int. J. Pharm.* (2004) 281: 1.
- (3) Florence AT. Announcing a new section on pharmaceutical nanotechnology in IJP. *Int. J. Pharm.* (2004) 279: 1-2.

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