

# Nanotechnology's impact on industry



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### *INTRODUCTION*

Nanotechnology applications are posed to have a large impact in medical, materials, and energy industries. With that in mind, the implementation and discovery of nanotechnology is the herald of what many are calling the second technological revolution. In order to appreciate the implications for our future one must have some basic understanding of what nanotechnology is, what it entails, and therefore why scientists and engineers are interested in it.

Nanotechnology and nanoscience essentially involves the study of materials when they are in the nanoscale around  $1/1,000,000,000^{\text{th}}$  of a meter. To put this into perspective a great example is given by Ratner (2008) that the human hair has an average width of 50,000 nanometers and bacterial cells are only a few hundred nanometers in diameter. Nanoscience often involves the study of materials where at least one dimension of the structure is less than 100 nanometers. At these scales the properties of materials are drastically different when compared their bulk counterparts.

This change is related to the size and geometry of the material. This phenomenon is, however, in stark contrast with common sense. One can visualize taking a piece of metal and dividing it up into smaller pieces. The individual pieces would have the same properties as the original such as melting point, conductivity, hardness, etc. However, as you continue to divide the sample into smaller portions, these properties often undergo vast changes once the sample reaches a size in the nanoscale. The discovery of <https://assignbuster.com/nanotechnologys-impact-on-industry/>

this phenomenon is what drives the interest in understanding and applying nanotechnology in many facets of our lives. In particular there is a strong interest in the uses of nanotechnology in the medical field.

Amongst engineers and medical professionals there is a growing consensus regarding the importance of the use and implementation of nanotechnology in the medical industry. According to Ashby (2010) the medical industry is one of the fastest growing areas of the research and development for nanotechnological applications. In fact, the number of potential medical applications for nanotechnology are limitless and it has been recognized that the possibilities for improving fields such as drug delivery and diagnostic techniques are profound.

For example, the possibilities for targeted area drug delivery are of great interest to medical professionals. As stated in Ashby (2010) there has been a long standing problem with modern drug delivery systems. The drugs often exhibit some undesired characteristics such as the lack of biocompatibility, stability, solubility, and absorption properties. Also, many drugs lose their potency as they travel through and interact with the human body. This in effect limits their use due to their decreased bioavailability as the drug reaches the desired location.

However, through the use of nanoparticle delivery systems with engineered functionality our ability to administer a drug in a targeted area allows medical professionals to circumnavigate the problems associated with modern drug delivery methods. Such methods, for example, would enable

medical professionals to administer drugs for cancer treatment in localized areas while also maintaining a higher degree of drug potency.

Also, as the nanoparticle delivery systems are very small it is believed that the likelihood of blockage and sedimentation in the smallest components of the human circulatory system is very low. Furthermore, the nanoparticles can be made to be biodegradable and consumable within the human body. This is a very important consideration as, for example, a blockage that occurs in the brain could result in a cranial aneurism.

Nanotechnology has also found application in a number of diagnostic techniques. In the medical field there is great interest in our ability to detect diseases in the early stages of progression. According to Ashby (2010) the use of carefully designed nanoparticles have been shown to be able to detect specific viruses, precancerous cells, and specific proteins with extreme precision and sensitivity. In many cases this would be extremely beneficial as early detection of the presence of numerous viruses and cancers would enable the treatments to be more effective.

Similar to the medical industry, the implications of nanotechnology in the materials industry are enormous. The application of nanomaterials are nearly limitless and apply to a broad spectrum of topics. Applications range from making a car seat water resistant or a tennis racket stronger to developing ultra-strong yet ultra-light materials for aircraft or making a material whose properties have never before been seen. In many ways' nanomaterials are posed to have influence in our daily lives even if we don't know they are there.

One great example in how our daily lives can be unknowingly affected by the presence of nanotechnology can be found in some modern refrigerators. In some refrigerators the inner wall is lined with a layer of silver nanoparticles that has antimicrobial, antibacterial, and anti-odor properties. Though it is not a substitute for routine maintenance of the refrigerator, it has been shown to significantly decrease the count of the bacteria present on both the walls of the refrigerator as well as what is on the surface of the food. This is a very simple application of nanotechnology that many consumers don't know has been applied.

Other applications of nanotechnology have been found in various aspects of sports. For example, carbon nanotubes have unique mechanical properties that are beneficial for many applications in the field of sports. An example given by Ashby (2010), some tennis racquets employ the use of carbon nanotubes in order to increase the strength and stiffen the racquet. Another example would be that some producers of golf clubs use carbon nanotubes to fill imperfections in the shaft materials improving the uniformity of the material and thereby improving the swing of the golf club. Though the uses of nanotechnology have had limited application in the field of sports, their presence often more substantial in other areas such as aeronautics.

In the aeronautics industry, according to Cao (2006), there is great interest in carbon nanocomposites for use in aircraft components. This is because fuel costs are a major expense for the aerospace industry and is proportional to the overall weight of the aircraft and its contents. Therefore, any material that can be used that has the desired mechanical properties but is lighter than the material previously used is an ideal choice for the aircraft

manufacturer. With this in mind the aerospace industry is very interested in carbon nanocomposites as they are very light and poses the required mechanical properties. This would enable the reduction in size and weight of various aircraft components making the aircraft lighter, faster, and safer all the while decreasing fuel and energy costs.

In fact, the possible applications for carbon based nanotechnology are very wide spread for the energy industry. Though they were previously mentioned for the mechanical applications in sports goods, carbon nanotubes have also been found to have very unique and efficient capabilities at converting solar energy into usable electricity. As the interest in solar energy becomes increasingly prominent as societies strive to meet their energy demands it is important to find more efficient means of converting solar energy into usable energy. In fact, according to Ashby (2010) the most modern and sophisticated solar panels only have a conversion efficiency of approximately 22%. It has been shown that when coupling current solar cell design with carbon nanotubes we can improve the efficiency of the current design.

Carbon based nanotechnology also has found applications in energy storage technologies. Graphene is a 2-D material consisting of a hexagonal structure of carbon atoms resembling a chicken fence. Graphene has been called a “wonder material” by many engineers due to its astonishing number of unique properties. According to Cao (2008) graphene has shown tremendous potential to be used in a number of energy storage devices. For example, graphene is extremely conductive and can be used to form supercapacitors capable of storing large amount of energy and dispersing it

in a short period of time. This capability stems from its two dimensional structure and very high conductivity which makes it ideal for use as a capacitor.

Graphene has also been shown to have numerous benefits when paired with existing energy storage technology such as lithium-ion and alkaline batteries. According to Ashby (2010), in batteries that have been hybridized with graphene in numerous ways, it has been shown that various aspects of the battery's functionality have been improved. These improved properties include, most prominently, a higher charge capacity and a faster charging rate. These are important improvements to the current designs of batteries we use in our everyday lives, but they are not the only improvements possible due to graphene applications.

Graphene is also a transparent and flexible material that will enable new developments in electronic devices and energy storage that were not possible prior to its discovery. Due to graphene's flexibility it is now possible for engineers to design flexible battery technology. This capability paired with graphene's transparency and conductivity it is possible to make flexible electronics. Engineers are already well on their way to developing flexible display technology with similar capabilities to a modern day smartphone.

In the end it is inevitable that nanotechnology will be implemented in our society one way or another. Whether it is in the medical, materials, or energy industries the possible future applications of nanotechnology in these industries, and many others, are endless. Even when we can't see it, even

when we can't feel its presence, or even when we don't know that it is being applied, nanotechnology will impact our lives one way or another.

## References

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