

NANOTECHNOLOGY: AN INTRODUCTION

Matthew N. O. Sadiku, Mahamadou Tembely, and Sarhan M. Musa

Roy G. Perry College of Engineering

Prairie View A&M University

Prairie View, TX 77446

Email: sadiku@ieee.org; mtembely@student.pvamu.edu; smmusa @pvamu.edu

ABSTRACT

Nanotechnology is the understanding of matter at dimensions of roughly 1-100 nanometer. It involves the creation and application of materials and devices at the level of molecules and atoms. It is a rapidly emerging field. This paper gives a flavor of nanotechnology and what may be expected in the future.

Key Words: Nanotechnology, nanomedicine, nanomaterials, nanoelectronics

INTRODUCTION

Richard Feynman, the Nobel Prize-winning physicist, introduced the world to nanotechnology in 1959. Nanotechnology involves the manipulation of atoms and molecules at the nanoscale so that materials have new unique properties. Nanomaterials are expected to have at least one dimension (length,

width, height) at the nanoscale of 1 – 100 nm.

One nanometer is a billionth of a meter, too small to be seen with a conventional lab microscope. Nanomaterials are known as nanoparticles when they have nanoscale length, width, and height.

Nanotechnology is a multi-disciplinary field that includes biology, chemistry, physics, material science, and engineering. It is the science of small things—at the atomic level or nanoscale level.

APPLICATIONS

At the nanoscale, materials exhibit unique electronic, optical, and electromagnetic properties, which have led to brand new applications of nanotechnology. The potential commercial applications of nanotechnology are vast and include nanodevices, nanomachines, nanomaterials, nanomedicines, nanomanufacturing, nanophotonics, and

nanoelectronic components. The limits are only known to imagination. As shown in Figure 1, nanotechnology is often referred to as an enabling technology [1].

1. Nanomedicine

This is perhaps the most important application of nanotechnology. Nanotechnology has the potential to revolutionize many aspects of medical practice including nanomedicines, drug delivery, diagnostic imaging, and clinical diagnostics [2,3]. Nanomedicine, an offshoot of nanotechnology, deals with specific medical intervention at the molecular scale for curing disease. It is at nanometer scale that biological structures inside living cells operate. At this scale, materials are more readily absorbed in the human body.

2. Pharmaceuticals

Nanotechnology is being applied to the pharmaceutical fields. The reason is to improve drug solubility. It is also being employed to develop new therapeutic devices. The use of various pharmaceutical nanocarriers has become an important area in nanomedicine. Nanotechnology promises precisely targeted

drug delivery of therapeutic molecules to the diseased areas of the body [4].

3. Food Sector

Nanotechnology has the potential of revolutionizing agriculture and food sector. Society may benefit from certain nanotechnologies for food applications. Nanotechnology has a potential way of enhancing agricultural production and packaging materials. This is almost unlimited potential applications of nanotechnology to food. Nano-encapsulated additives have been used in food. Nanotechnology materials are being used in many ways without consumer knowledge. Consumer acceptance of nanotechnology is critically important [5,6].

4. Nanoelectronics

This refers to the application of nanotechnology to electronic components. The development of nanotechnology has been driven by the electronics industry. Nanodevices have much higher manufacturing defects rates and have more sensitive to noise induced errors. It is believed that silicon will be the main platform for nanoelectronics for the foreseeable future [7].

RISKS OF NANOTECHNOLOGY

All newly emerging technologies pose challenges and uncertainties. It is important to know about the short-term and long-term benefits, limitations, and risks of nanotechnology. Because of the wide range of applications of nanotechnology in food, electronics, medicine, and other industry, there is no federal agency with jurisdiction over nanotechnology. That implies that there are no regulations for nanotechnology right now. The current position is that current safety and health regulations are enough to address the risks associated with nanotechnology. In other words, existing regulations are sufficient [8].

CONCLUSIONS

Nanotechnology has the idea that the technology of the future will be built on atoms. It has impact on every area of science and technology. It is in a rapid pace of development and is already reaching an advanced state. In spite this, nanotechnology remains relatively unknown to the general public. Like its predecessor technologies, nanotechnology will have impact on all areas. Experts appear to be optimistic about the potential benefits of nanotechnology.

The United States is committed to being at the forefront of nanotechnology research and development. To achieve this, there is a need to educate a new generation of technicians, engineers, scientists, educators, entrepreneurs, and policy-makers. Students at a younger age must be exposed to nanotechnology. Nanotechnology education is becoming a national priority in several countries. Different nanotechnology courses and programs have been developed with success [9-11].

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About the authors

Matthew N.O. Sadiku (sadiku@ieee.org) is a professor at Prairie View A&M University, Texas. He is the author of several books and papers. He is a fellow of IEEE.

Mahamadou Tembely (mtembely@student.pvamu.edu) is a Ph.D student at Prairie View A&M University, Texas. He received the 2014 Outstanding MS Graduated Student award for the department of electrical and computer engineering. He is the author of several papers.

Sarhan M. Musa (smmusa@pvamu.edu) is an associate professor in the Department of Engineering Technology at Prairie View A&M University, Texas. He has been the director of Prairie View Networking Academy, Texas, since 2004. He is an LTD Spring and Boeing Welliver Fellow.

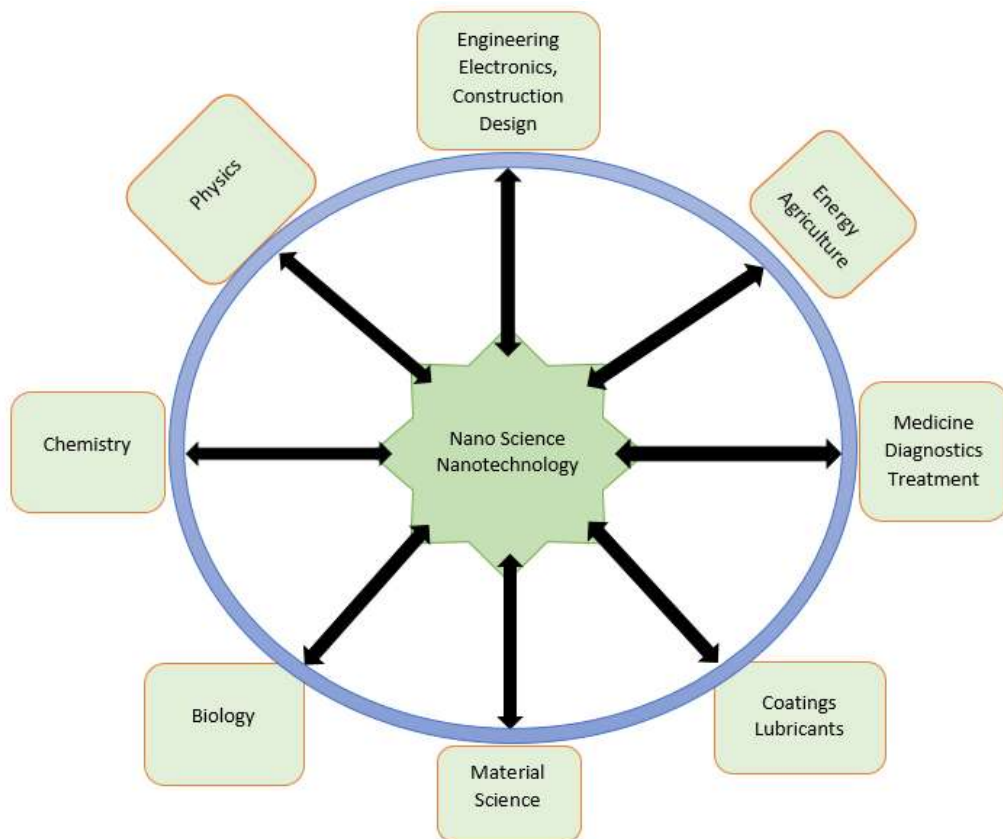


Figure 1 Relationship of nanotechnology with traditional disciplines [1].