

# Applications and Future Scope of Nanomanufacturing in an Emerging Technical Field

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**Abstract**— This paper provides an overview of advancements in the emerging field of nanotechnology in segments like conventional materials, electronics, medicine, energy conservation, and transportation. Also, discussion on how this technology provides mobility, intelligence, and nano-structures in the devices that are carrying out needs of typical individuals, where those people are not in the position to do these kinds of stuff over the past decades. Nanomanufacturing in the medical field, providing nanoscale devices to save lives and helps explore human anatomy in deep. Nano-manufacturing gives a deep insight into the emerging techniques in building futuristic products, which are science fiction for our existing generation.

**Keywords:** Nanotechnology, Nanomaterials, Nanomanufacturing

## I. INTRODUCTION

Nano-manufacturing is the manufacturing process where products on the scale of nano are made. Which possibly be in between one and one hundred nanometres on the scale. There is a need of nanomanufacturing in today's trend of decreasing size of products and the energy consumed by large modules which will surpass by productions of nanoscale products having same properties and functions of large-scale products that consume low energy and proved functional work. Mr. R. Feynman, the professor of Californian institute of technology given a lecture back in 1959 when present at the session of the American Physical society titled "There is a lot of space down there" which we can say the origin of nanotechnology. [1] Nanomanufacturing is also growing its knowledge in many fields of engineering, biomedical and information technology sectors by reducing the size of products used daily and with better functions of use and also fulfil the need in advanced manufacturing and nano bio-interactions to develop multi-functional instrumentation and construction tools for ambivalent data interpretation. Nanotechnology empower us to modify the molecular structure of products for making an all-new type of products and increase their potential like if we move and re-arrange the atoms of sand we can easily make computer chips, and it also happens in the case of diamonds which are the results of atoms rearranging from coal which are harder than coal and different in all parameters.

Nano-manufacturing is based on two approaches of manufacturing where one "top-up" refers to slicing or consecutive cutting of an ample material to get nano-sized particles, and "bottom-down" relies on the manufacturing of parts from the nano-scaled material. [2] Nanoscale materials have been used for over decades. As an example, nanoscale gold was used in stained glass in medieval Europe, and they found nanotubes in blades of swords made in Damascus capital of Syria. [3] However, inventing high powered microscopes before ten centuries, allowing us to see things at

the nanoscale and begin working with these materials. [4] To achieve lightweight, higher strength in materials and increased control of light spectrum, engineers are finding all the possibilities in the nanotechnology because of nanomanufacturing escort to the production of successively improved materials and new products in our day to day lifestyle. Thai Government publicized their plan in May 2004 to use nanotechnology in all products at least by one percent of the total by 2013, which then their market value is estimated more than US\$320 billion. According to the statement given by UN Millennium Project task force on science technology and innovation is "nanotechnology is likely to be particularly important in the developing world, because it involves little labor, land or maintenance; it is highly productive and inexpensive; and it requires only modest amounts of materials and energy" With continuous growth in technology, we are in a position to create Future Force warrior, which will totally convert a regular soldier into an "F-16 on legs". [5] Decades before if a woman needed to confirm her pregnancy she has to visit the clinic, and there is no surety if clinic staff will keep her report confidential, but now with nanomanufacturing, one can test her pregnancy at her home with full privacy. [6] Nanoworld is entered into our daily life and helps complete our major words with little efforts.

## II. SCOPE

Nanotechnology is a vast field of study where it enables us to do advancement in different fields of work and deeply study previous work so that we can improve our designs and products for more efficiency and reliability. More efficient products with long lifespan enable humankind to save more resources, and these small dimensional devices can reach to those places where no human eye can reach. Nanomanufacturing technology can create complementary parts which have unique shapes that lock each other for making an object which we have seen in the sci-fi movie "Star Trek," those machines are called replicators, and they can quickly produce rationally any physical object. We need trillions of nanoscopic machines which will handle molecules and atoms and replicators those could possibly be occupied space less than a cubic millimeter, and we cannot see them with the naked eye, then these can make products and replace all traditional machinery. [7]

### A. Nanobots

These are tiny bots which are used for curing diseases in the human body where our heavy machinery cannot reach, and these are the robotic structure science fiction movie like where hero built a nanobot to go into the human body and do research. However, this technology is not fully developed, but in future nanotechnology helps mankind to do this type of work by making tiny robots. These tiny robots have a tendency to work effectively when grouped with other same

category robots. [8] Tiny robots can release the specific drug in targeted body cells for faster recovery of the human body. [9]

#### B. Hydrophobic Materials

As we know, nano-coating is applied to materials for repelling water to improve lifespan of that product. [10] Nanotechnology can be improved more for more efficient and more durable on other products which are vulnerable to water and moisture. In routine Umbilical Cord Care, we can now prevent infections caused in newborn babies. [11] By using the heterogeneous structure of the *Slavonia molesta* and imitating its properties, we can reduce the risk of cavitation due to bubble pocketing inimical to encroachment. [12]

#### C. Food and Agriculture Industry

Food and agriculture sector needs more improvement so that we can achieve more output with low-cost materials. We can use nanomanufacturing for creating a system like wastewater filtration and for removing salt particles from the water to make usable in different situations. Nanomanufacturing enables us to make nanoscale pesticides so that they can be absorbed quickly and can be reduced quantity used for fields. Nanoparticles facilitate us to provide pesticides and fertilizers at the right time and on the aimed location. [13]

#### D. Chemical Industry

As we know, all the chemical work is done on a small scale, so we use nanotechnology in the chemical industry. Manufacture nanosystem for closely watching these reactions on a small level of detail we can carefully observe reactions, by researching more on this study we can do complete reactions without energy loss and lead to more magnificent discovery in the chemical industry. [14] Nanotechnology is used for creating biochemical sensors which are based on navel sensing materials and can be implemented for both stoichiometric and non-stoichiometric fore-runner. [15]

### III. APPLICATIONS

Nano-manufacturing is emerging in many fields, i.e., medical industry, aerospace engineering, chemical industries along with used to build power-efficient products. Nanotechnology can be defined further into different industries where we get to benefit from nano manufactured products. We can see a product made from nanoparticles all-around of us; we are totally covered with this new technology which makes us efficient and more productive in our daily life from low to top work. In every division of science, we have increased the use of nanotechnology.

#### A. Nano-Medicine

Nano-manufacturing helps in the growth of nanoscale medical appliances, which make us possible to cure diseases and deeply study human anatomy. [16] By applying nanomanufacturing, we can examine body cells, tissues, and bone. Nanoparticles made us able to make drugs which deliver the antidote to the specific part of the body. MicroRNAs with the assistance of nanotechnology, we can cure ovarian cancer. [17] Engineers are now capable of creating nanorobots with sensing proficiency which go inside

the body and diagnose full body from inside without cutting body skin to see inside. [18]

#### B. Nano-Biotechnology

Nanotechnology is an intersection of nanotechnology and biology. Nanobiotechnology can also be stated as it is the utilization of biological design or fabrications which are applied in medicine or biotechnology. Detection of DNA and separation to protect it for long term preservation and study for future discovery and can be used as a reference. [19] For diagnosing breast cancer, we can take help from fluorescence and computed tomography imaging technology with the use of rare-earth-doped nanoparticles. [20]

#### C. Green Nanotechnology

Green nanotechnology is a field of study where we figure out new ways how to save the environment by implementing nanoscale technology to reduce pollution and increase their efficiency.

It helps us in decontaminating effluent and make it drinkable. [21] Solid-state gas sensors based sensing devices can be used for detecting air pollution in any particular area and also gas leak monitoring in factories which are prone to gas leak problems. [22]

#### D. Industrial Applications of Nanotechnology

Today's industry tries to make compact devices and reduces dimensions of their product by adding more functionality using nanotechnology. Nanotechnology assists industry to reduce weight more concerned than any other factor likewise in oil extracting industries which are using nanotechnology for more than 50 years for making lightweight drills to go through clay. [23] Nanocoatings and improved fabrics assist automobile industry for making lightweight structures with a muscular body. [24]

#### E. Potential Applications of Carbon Nanotubes

The diameter of nanotube varies from 0.8 to 2 nm and 5 to 20 nm for both single wall and multi wall nanotube respectively. Efficient electromagnetic wave absorption with the use of MWCNT/NiO-Fe<sub>3</sub>O<sub>4</sub> hybrid nanotubes. [25] Nanotechnology brings new advancements like utilizing atom structure so that we can make more small size nanotubes as compared to today's tubes.

#### F. Nanoart

Nanoart is consists of science and technology where we combine science principles with technology to create art at the nanoscale. With nanotechnology, we can advance in the synthesis and manipulation structures like graphene for widening its applications in real-world applications. [26] Animation reached a new height with the entry of biology at the nano-scale, where we can render the whole scene of sperm journey, which very great details like his tail movement. [27]

#### G. Aerospace Industry

The nanotechnology assists old technology used for making aerospace vehicles. Working on their material, we can get max performance along with stability at a higher altitude while navigating through the atmosphere. [28] With the use of nanomaterials, we can increase the thermal capacity of

the outer body of the airplane, which happens with high speed. [29]

#### IV. CHALLENGES OF NANOMANUFACTURING

Every technology came to the planet tackled many problems, initially, technology has some ambiguities which need to be condensed so that we can adapt that technology without any distress. There appear to be some adverse effects which arise while using nanomanufacturing, and we need to work on them for finding a solution and get a positive reaction from this technology. Same like in nanomanufacturing, to make this theory into the real-world application, we have to make it affordable and efficient, so it can help us in our real-life usages and ease out our workload

- Common challenges faced by nanomanufacturing are developing production techniques that are cost-effective and economical.
- We need to be precise in a congregation of nanomaterials.
- We have to develop methods for the detection of defects arises in nanoscale materials.
- We need to make nanoscale materials robust, and they should not change their properties while working on nano size.
- Nonmanufacturing needs unique methods which are not accessible to all.

#### V. RESEARCH OBJECTIVES

Our main objective for nano-manufacturing is to conduct research programs which will enhance the stability of nanoscale materials and boost the performance of a nanosized material. R & D will open new doors for this technology which may possibly be beneficial to mankind, and that will also bring out some incredible inventions. Encouraging scholars to discover all possibilities in this industrial sector will increase more chances of great inventions.

Most common research objectives for nanomanufacturing are:

- Make nano-technology economic and stable for all industries.
- Production of nanosized materials should be throughput and yield
- Make nanomaterials non-changing their material properties when we shape them.
- Imperishable materials at the nanoscale.
- Simplify process accessible to the economy.

#### VI. CONCLUSION

Nanomanufacturing has a broad scope in future applications of emerging technology for making small nanoscale products having more uses than nowadays. There are more advancements which will happen in the MEMS field of technology.

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