

# Defence applications Of Nanotechnology: Development And Strategies

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## **Abstract**

*The technological advancements in nanotechnology has opened new frontiers to mankind. The core area of this unique technology is precision in science and technology with smaller particles. Due to such features the new areas are targeted for application of nanotechnology and military applications are among the newest emerging fields and there are numerous applications for nanotechnology are numerous, ranging from sensing Weapons of Mass Destruction (WMD), protection kits and medical aid (infection control), materials having self healing ability and nano-electronics.*

**Keywords:** *military applications, nanotechnology, research and development*

## **1. INTRODUCTION**

The term nanotechnology deals with “the design, characterization, production, and application of structures, devices, and systems by controlled manipulation of size and shape at the nanometer scale (atomic, molecular, and macromolecular scale) that produces structures, devices, and systems with at least one novel/superior characteristic or property.”[1]. Utilizations of nanotechnology based materials are not new. Indeed, its applications were utilized a very long time before nanotechnology as a field was officially characterized, in making artistic creations or making steel [2]. The entirety of the world's significant military forces is intensely engaged with innovative work of nanotechnology imbued materials and frameworks. Starting at now, nanotechnology explore centres around improving clinical offices and delivering light weight, solid and multi-useful materials as armours that encourage both insurance and upgraded availability in a Network-driven fighting area [3] Nanotechnology without a doubt gives bunch new choices to the military. Nanotechnology discovers applications in both regular citizen and military areas. Huge numbers of the utilizations of nano-advances are being created in the regular citizen domain which may before long discover a spot in the military field. Country states are thoroughly progressing in the direction of building abilities in the field [3]. Thinking about the fundamental notability of nanotechnology, even India has been investing a steady exertion in the field. In India Nanoscience and Technology Initiative (NSTI) was set up by the legislature of India to look for nanotechnology research. From that point forward India has made some amazing progress. DRDO is doing broad work in the field of nanotechnology to improve its application in safeguard part. Significant center regions have been NBC (Nuclear, organic and Chemical) assault assurance gadgets, stealth and disguise, sensors, high-vitality

applications, nanoelectronics, auxiliary applications. DRDO has likewise set up nano research and creation office in different pieces of India[4].A Bengaluru based Log-9 Materials startup is also collaborating with the defense industry to help it build various products and applications while conserving energy and sensor [5, 6].The high sensitivity of nanometer range fibres towards chemical as well as biological warfare, this makes sensing surfaces very effective [7].

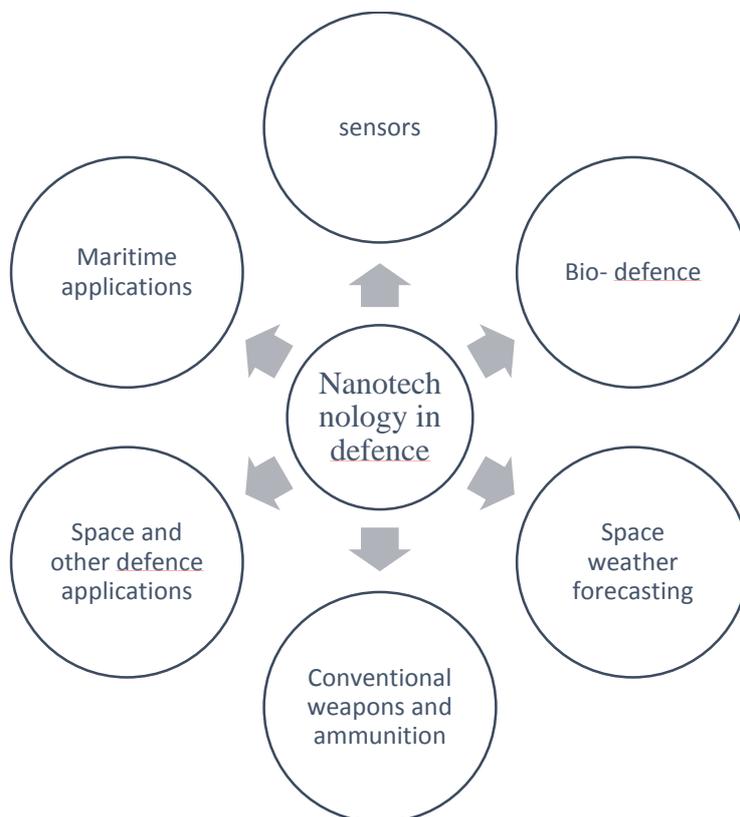


Fig 1 Applications of nanotechnology in defence

The developments in nanotechnology especially in nanostructures and nanocomposites are being done for the following military applications

- Lightweight protective clothing
- Flexible antiballistic textiles
- Chemical and biological warfare protection and self-decontaminating Nano fiber fabrics
- Adaptive suits like switchable fabrics for improved thermal control, switchable camouflage.
- Micro sensors for body and brain sensing, environmental and situational awareness, integrated into a smart suit or a smart helmet.

- Wearable and/or flexible displays for visual feedback auxiliary supports: Flexible/rigid textiles for additional strength, exoskeletons, and robotics to assist the human tasks.

## *Defense applications of nanotechnology*

### *1) Fabrics/Materials (Nano suits)*

Nanofibers made from electrospinning techniques have several attractive features which includes- (i) softness potential of acting as a barrier against microorganisms and fine particulates; (ii) a potentially good strength per unit weight; and (iii) a high surface energy that indicates a potentially good vapor transmission rate. Soldiers often need to carry heavy load of equipments. Likewise, their attire doesn't give them a full verification insurance from shots. Numerous Nanotechnology R&D offices are thoroughly engaged with creating "nano-battlesuit." This battle-suit could be as slim as a stretchy polyurethane texture and contain wellbeing screens and correspondence gear. Vitality for correspondence could be created by ordinary body developments. Furthermore, this material would give quality far superior than the presently accessible materials and furthermore encourage successful insurance from bullets [8]. Along these lines, nano-fight suit permits the military to scale down that eliminates weight as well as improves productivity and assurance. The developments have taken place in this concept are Signature Reduction, ballistic Protection, fire-retardant fabrics, chemical/biological protective nanocomposites, self-cleaning, healing, and decontaminating fabrics and sensor and energy-storage fabrics[9].

### *2) Robotics and Security (Nano drones)*

Nano-drones contains cameras and sensors like any mobile device and also the feature of facial recognition. With modifications military nano-drones could also include few grams of explosives which would be sufficient enough to penetrate the skull and destroy the contents. These nano-drones whenever prepared as a group could enter structures, vehicles, trains, dodge individuals, shots, essentially every counter-measure and consequently are sufficiently deadly to execute half of the city [10].

### *3) Weapons*

#### *(a) Detection using Nano sensors*

Nanotechnology permits smaller sensors which could discover applications in different segments. For example, incorporating these nano-sensors with neural systems can help recognize and distinguish amazingly little hints of airborne chemicals. A variety of these sensors will be of incredible use to the outskirt powers taking a shot at the bleeding edge, to decide the nature and greatness of the potential hazard when explosives are detected[9, 11]

#### *(b) Defence (nano- implantation)*

Nano- Systems implanted within human bodies find application in monitoring the medical health and also the stress condition of a soldier, release of therapeutic agents and hormones as required. Among such application is linking such systems to the brain cortex areas or the sensory organs which include sensory nerves, motor nerves or muscles to effectively reduce the reaction times for the soldiers [3].

#### *(c) Development (nano- nuclear, chemical and biological weapons)*

In spite of the fact that there would not be any basic difference in the quality of nanotechnology induced nuclear weapons. Only the overall yield would be pretty low, and the mass and size correspondingly become small, making the distinction with conventional weapons blur. This would likewise reduce the overall destruction caused. On the other end, nanotechnology would provide qualitatively new choices for inducing biological or chemical weapons. Nanotechnology induced synthesis makes biological/chemical warfare much more effective and easily manageable. Nanotechnology could actually easily facilitate the entry of various components into the body or cells. Mechanisms could be structures using nanotechnology with the end goal of restricting damage to one's own force, such as self- destruction after a defined period of time or reliable inoculation[12].

#### 4) *Stealth movement (Nano satellites)*

Nanotechnology would give indefinite numbers of potential outcomes in the outer space. For starters, utilization of nanotechnology can be done for markedly smaller satellites together with smaller launch vehicles. Thus, making these satellites financially cost-effective. also these nano-satellites finds applications to be used in swarms for radar, communication and intelligence. These satellites could also facilitate the devoted task to capture high resolution images of enemy territory[13].

#### 5) *Military Personnel health*

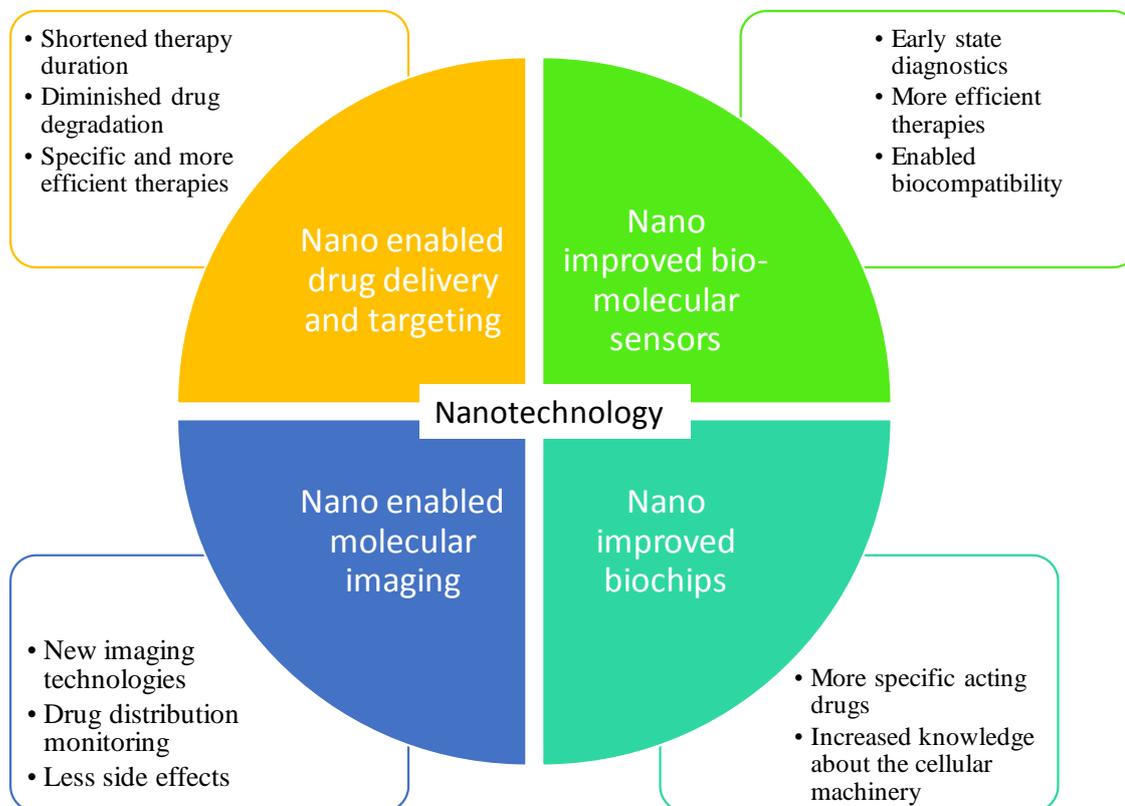


Fig 2 Applications of nanotechnology in ensuring military personnel health [9]

*a) Medicine*

Nanomedicine is product of the medical application of nanoparticles[14]. It includes biological devices, nano-electronic biosensors, and even possible future applications of molecular nanotechnology such as biological machines.Nanomedicine seeks to deliver a valuable set of research tools and clinically useful devices in the near future [15][16]. The National Nanotechnology Initiative expects new commercial applications in the pharmaceutical industry that may include advanced drug delivery systems, new therapies, and in vivo imaging [17]. One of the most anticipated uses of nanotechnology in medicine is for the development of new classes of pharmaceuticals and drug delivery systems, especially for targeted therapies[18]. Targeted drug delivery systems offer several advantages versus traditional drug administration routes including:Improvement in patient compliance, treatment efficacy and specific localization; decrease in toxicity; reduction in dose used; better control over biodistribution and better pharmacokinetics [15-19].

*b) Diagnosis*

The basic unit of life, cell carry out numerous biological activity contain organelles with biomolecules in nanometer range.There is lot of research over designing nanometer scale machines and tools that can enter the human body. Various nanomaterials based sensors has been under development for various defense and routine diagnoss activities. Sensors may be developed for food safety and disease diagnosis. In depth studies regarding monitoring stress levels, disease, inflammation, requirement of nutrition needs to be conducted in future [19, 20]. Nanotechnology has prominent role in targeted drug delivery and many studies are going on in this aspects. Novel drug delivery strategies have been discussed by Sharma et al. (2019) in lung cancer including the use of nanoparticles in this aspect [21].

Nanotechnology has wide applications and various studies are going on to enhance the efficiency of nanoparticles in their function in different aspects [22-31].

### **3. CONCLUSION**

Defense applicationof nanomaterials includevehicles and many weapons based on nanotechnology. Development of nanotechnology-based protective clothing for defence personnel is one of the important areas where all the major powers of the world are making efforts to do research and develop new materials. Apart from materials and sensors/electronics, NT also has direct military applicability towards making toughened armour, producing tiny surveillance devices,improving the performance of UAVs/UCAVs and enhancing interfacing and targeting for soldiers and fighter/bomber pilots. Particularly for states like India, nano sensors would have a great potential for real-time border surveillance through wirelessnetworking.There is alsoa need to engage the military in the process of research, development, and planningfrom the beginning. Lastly, there is a need to look at the military utility of NT not inisolation but along with a few other technologies like information technology and biotechnology.

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