Xournals

Academic Journal of Nanotechnology

ISSN UA | Volume 01 | Issue 01 | January-2019

Nanotechnology and its Military Applications

Nabanita Phukan[1]

Available online at: www.xournals.com

Received 8th September 2018 | Revised 17th October 2018 | Accepted 15th December 2018

Abstract:

The most emerging field in science and technology with a large number of ideas and application is Nano-science and Nanotechnology (NT). It is expected that nanotechnology brings revolutionary changes in many areas with great risks and benefits. In the field nanotechnology the research in defense and development expanding very rapidly. Many countries and states are taking a serious interest in the application of nanotechnology in the defense field. Nanotechnology holds many great promises. Nanotechnology will permit a new kind of weapons that will change the geopolitical setting leftovers to be realized. Numerous uncertain safety enigmas led to the occurrence of nanotechnology have conclusions for defense policy, arms control, international security, and in many other fields. For the social and economic gain, many programs were initiated globally. This paper examines the effect of Nanotechnology on defense by studying the global trends and the evolution of nanotechnology in India is also be discussed. The existing and forth-coming application of nanotechnology for military purposes, as well as other expected influence on arms control, is also discussed.

***Keywords**: Nano-technology, Impacts, Future, Defense*

Authors:

1. *Indian Institute of Technology, Kamrup, Guwahati, Assam, INDIA*

Introduction

Nano-Technology has two important but different meanings. One is that in which any technology handling something smaller than 100 Nano-meter in size. The other meaning is referred to building and creating of machines in which every chemical bond and the atom is surely detailed.

The advancement of science and technology gives the structuring of matter at the scale of a nanometer (1nm = 10-9m, a billionth of a meter). As we see the advancement of nanotechnology it will become the backbone of future fundamental technology. Nanotechnology is an interdisciplinary as well as a multidisciplinary area of investigation and application. The broad spectrum of applications that nanotechnology is and will be providing to speaks of its omnipresence. Be it in electronics, textiles, agriculture, medicine, energy, cosmetics, healthcare, transport, construction, water treatment etc.

The occurrences and handling of resources at atomic, molecular, and macromolecular measures, to understand the qualities which considerably differ on a large measure is generally known as Nano science. As per the US: National Nanotechnology Initiative

"Nanotechnologies are the application of structures, devices, characterization, design, production, and systems which are controlled on the basis of size and shape on a nanometer scale. The properties like chemical, physical, biological, electrical and other behave in an individual and unique way at this scale. So the properties of uniqueness and individuality open up many new way or ideas for their application and enquiry".

Nanotechnology is the process of assimilating and controlling of any matter at measurements of approximately 1 to 100 nanometers, where distinctive portents enable fresh applications. Incorporating Nano scale science, technology and engineering comprise measuring, imaging, manipulating, and modeling matter at this length scale.

Being a developing skill, nanotechnology is in a promising phase of its innovation, research, and development. It is different from all the other technologies. At this present phase of growth, nanotechnologies are being continually improved and updated. For the socio-economic needs nations try to build all the possibilities offered by the modern science and technology, but there is a need for a wide range of practices and organizations.

As there are many wider applications of nanotechnology so the experts have numbered a list of top ten nanotechnology application areas which is mainly for the concern of developing countries such as India with respect to UN Millennium Development Goals (MDGs). Indian defense face many different types of threats like terrorism and rogue nations. Which are not only advanced with lethal weapons but also with biological and chemical welfare weapons. In the Indian defense system, the protective cloth used is not good enough for modern weapons. The weaknesses like bulkiness, high cost, discomfort in wearing and many others make them imperfect. The material based on nanotechnology offers a promising future in the area of defense due to its extraordinary chemical, physical, mechanical and other properties at Nano- level.

According to Shri AK Antony:

"Nanotechnology is an evolving ground, which can result into the expansion of new weapon systems and products that can profit our nation".

Nanotechnology offers many features which will make it suitable for many applications. The properties offered by nanotechnology include:

- Light-weight
- Highly adaptive structure
- RF tailored properties including, stealth and camouflage
- Hardness and all-impacts resistance

Global Trends

To influence the abilities of nanotechnology the world wide governments have launched many initiatives and programs for the economic and social gains. In 2005, more than 62 countries launched national specific activities.

In 2001, the USA announced the National Nanotechnology Initiative (NNI) these efforts of research and development (R&D) was significantly promoted over the world. National Nanotechnology Initiative is the most inclusive R&D programme in the world with the technology of Nano-science. On the groundwork laid by the NNI Most advanced countries have based their own programme.

The National Nanotechnology Initiative mainly focused on the development and research of Nano-scale science for the benefit of security and economy.

- Most of the countries in Europe have government supported nanotechnology research and development (R&D) initiatives.
- Through its medium and long-term programme, China has also invested in nanotechnology.
- To offer a structure for the accountable growth of empowering machineries such as

nanotechnology and other new technologies Australian Government launched National Enabling Technologies Strategy (NETS).

- Taiwan develops the world's first government-established system for certifying Nano-products.

On nanotechnology research and development, globally the government spend more than US$ 10 billion per year. The total government subsidizing for nanotechnology study globally was more than US$ 65 billion by the end of the year 2011.

Evolution of Nanotechnology in India

To promote the research in frontier areas of science and technology like Nano-material, neuroscience, robotics the national facilities and core groups were set in 1998-2002, the 9th five-year plan. Under the basic research, the planning commission supported a various number of research and development programs.

In 2000, Department of science and technology (DST) launch "Programme on Nano-materials: Science and Devices". After realizing the importance of nanomaterial many special initiatives are also launched by the DST to support and generate some end to end ventures resulting to products and machineries.

On "Nano-materials: Science and Devices" In 2001-2002, a set of expert group was set up by DST and in the 10th five-year plan (2002-07) government identified the need to initiate Nano-materials Science and Technology Mission (NSTM).

In 2001, under the sponsorship of the Department of Science and Technology of the Ministry of Science National Nanoscience and Nanotechnology Initiative (NSTI) was launched. Its aim is to create research in Nano-science and Nano-technology. With implementations in nearly every facet of life, nanotechnology was indicated as a revolutionary technology.

To nurture, develop and promote all features of Nano-science and nanotechnology a Mission on Nano Science and Technology (Nano Mission) was established on May 3, 2007, by the DST. The primary motives of the Nano mission are:

- Development of Groundwork for Nano Science and Technology Research.
- Public-Private Partnerships and Nano Applications and Technology Development Centers
- International collaborations
- Industry-Academia partnerships to be encouraged under these programs

In 2012-2017 the Twelfth Five Year Plan, approval was passed by the Government for the continuance of the mission on Nano Science and Technology in Phase-II at a sum total worth of Rs. 650 crore. In this new phase, great efforts were made to promote application-oriented R&D for the result of some useful technologies, products, and processes.

The development of Nanotechnology accepts noteworthy sustenance from many Government agencies, however definite funding levels are hard to assess. Nanotechnology research in Defense Research and Development Organization (DRDO) labs includes applications like:

- Nano-magnetic material
- Gas sensors
- Low-emissivity films and coatings
- Nano-composites
- IR reflecting coatings
- Materials for thermal insulation
- Magnetic nanoparticles to fuels and lubricants
- Polymeric Nano-composites
- Toxicity of engineered Nano-materials
- Semiconducting Nano-crystals
- Metal nanoparticles and their composites.

Nano-Technology and its Military Usage

The application of nanotechnology in defense is abundant extending from detecting the Weapons of Mass Destruction (WMD), medical aid (infection control), to self-healing materials, combatant protection kits and in Nano-electronics.

Nanotechnology is a developing technology and in the military, the demand for in-depth research and development is more. In this section, we discussed the existing and futuristic impact of nanotechnology on the military.

Electronics/Computers/Sensors

Nanotechnology is making great development in the field of electronics. The application of NT gave a significant increase in the enactment of memory, processors, embedded intelligence systems, displays, and solar-powered components and reduce the prices. NT offers the best solution for the miniaturization which is expected to help the microprocessor to run fast. The size of computers and electronics will become much smaller and much faster. This system introduced a new advancement of artificial intelligent which will be used all through the military even in the minor machinery (uniforms, glasses, rifles, mini- and micro-robots).

In some cases, the limitation of other technology comes forward with the nanotechnology enables equipment like it is possible to reduce the size of an electronic device with the help of NT but here the problem comes because the size of battery shouldn't deflate in correspondence. Therefore a micro-meter sized arrangement needs a centimeter-sized power supply. So more research is needed to produce the Nano-electronics over these limitations.

In general, nanotechnology is expected to be revolutionary in the field of IT and making a new way of research and development. From the perspective of the military application, the need for nanotechnology in the field of computers, sensors, and electronics would fundamentally move around by decreasing the dimension of gadgets and making them more competent. With the use of nanotechnology in sensors, LEDs, and wireless communication component a network is produced not on the battlefield but also for the logistic department.

Bio-Defense

In bio-defense, nanotechnology is the fastest evolving fresh frontline. In the development of bio-sensor nanotechnology is primarily made use of. In the manufacture of chemical biological mass spectrometers, which are employed to sense biological warfare agents nanotechnology is found very useful. For cell death, this technology is very helpful, with this molecular objectives can directly insert into the cell or simply exposed to the environment. Many cells are measured in nanometers where a number of life sustaining activities and the contact of protein surface takes place. By using the Nano-chips the cost of drugs and virus development can be reduced. In the field of bio-defense nanotechnology is displaying enormous promise in the expansion of countless direct and indirect implementations. A decent quantity of advancement is described in the field of bio-defense particularly in the various design of carbon-Nano-Tube (CNT).

Maritime applications

Nanotechnology shows a great potential for maritime usage. Nanotechnology is probable to be a dire constituent of a ship's system construction. Mainly the design and manufactures are set on microelectronic and nanotechnology. The present work toward the development of electric warship would transform the use of navy's weaponry and manpower. Under the most harm condition, the electronic packaging of micro and Nano-scale are likely to maintain the consistency, resulting from power loads, high-current density and high temperature.

The research and development organization of US Navy's offer a perilous substructure for executing multiple disciplinary effort at the Nano-scale and grave changeover routes for Nano-science and Nanotechnology into the application of interest like as Combat-Safe Insensitive Munitions. To get revolutions from the bench of the navy, products like functionally classified Nano-composites are stimulating examples of nanotechnology. The advance navies take nanotechnology as an area of importance and opportunities. Nanoparticles in the views of an expert can be used to mark navigable channels, ships, delimiting safe heavens, and fishing boats.

Conventional Weapons/Ammunition

It is believable that light weapons and small arms could use locks, barrels etc. made of Nano-fiber complexes. The nanotechnology-based material makes the weapon stronger and lighter. Employment of advances in explosives and material, conventional guns could reduce the mass and larger ranges should be targeted. Even in the ballistic and air-breathing weaponries, the reduced mass could transform into an upsurge in range, payload, and speed, and also reduce the size of the carrier. It was also said that nanotechnology-based improvised explosives and propellants are probable to enter into the usage of the military within a time duration of decades. Guidance system which is based on nanotechnology pointing accurateness could upsurge evidently this is identical for missiles. Nanotechnology-based armour will overcome over NT penetrators or vice versa is an open question.

Space weather forecasting

From the region of space like ionosphere the sensor based on nanostructured sensors are probable to play a vital role but the knowledge of weather near earth and the environment of solar space would become serious at this phase. The navigation and communication would be governed by the space based system, therefore, in upcoming, the dependence of military on space belongings are likely to increase.

Soldier-worn systems

Soldier worn system which is based on the nanotechnology could sense the state of health of the wearer. The reaction of the system is done by emancipating drugs or, using smart materials, by reducing wounds. By the moments of the normal body, the energy for communication could be generated.

Space and other defense applications

By the smart use of sensor and information technology, it can be possible to enable more precise transfer of force and lesser collateral damage. The advancement of light-weight and strong material would also release great energy. In satellite manufacturing, the material used is less vulnerable corrosive material, therefore, Nano-structural material shows a prominent promising structural application. The material also very positive change in the manufacturing of cars in which the strength and weight are improved by 10 to 15 percent, with a promise of 20 to 25 percent. In designing the unmanned aerial vehicle or combat aerial vehicle nanotechnology plays a very important role.

Today's generation of satellites utilizes thruster rockets to change orbit or to stay in the orbit. The fuel they carry on board is used to determine the life of this satellite, and because of inefficient and incomplete combustion of fuel such as hydrazine more than one-third of the fuel is misused. For incomplete and incompetent combustion, the main reason is onboard initiator wear out rapidly and conclude to accomplish the job efficiently. For enhancing the life performance of these igniters Nano-materials, such as Nano-crystalline tungsten-titanium diboridecopper composite, is probable. As a power of source satellite uses solar power apart from onboard fuel in outer space.

To diminish the weight of such solar cells, the designer of satellites are working continuously. To their conventional counterparts, space and defense scientist are trying to adopt the material like nanomaterial as an alternative material. In the defense industry, for the manufacturing of spacecraft, the lighter non-porous material like aerogels are found to be very applicable. Even with the use of aerogels many special light-weight jackets and suit could also be made.

The threat from nuclear, chemical, biological and radiological terror (WMD) nanotechnology offers a solution against the usage of chemicals like HD, GB, GD, and VX. The oxides of CaO, MgO and Al2O3 interact much faster as if compare to micro-particles and are well suited for the fast decomposition.

Conclusion: The recognition of nanotechnology is as a very robust innovation driver and it is seen as a most planned technology for the world's forthcoming economy influencing practically all technological sectors including defense and safety. India has made significant progress in nanotechnology research. Nanotechnology in India is the most emerging technology with a huge potential to address challenges. The government of India starts many initiatives for research and development on nanotechnology to increase the application in many fields. The application of nanotechnology in military offers a great future. From the advancement of numerous sensors to soldier protecting kits nanotechnology gave its own important impact. The research or defense scientist of India needs to work in tandem with their other national colleagues as there are a lot of unities in the civilian and military fields of Nano-technology. This technology should lead to higher protection, longer endurance, more lethality, and better self-supporting capacities for the soldiers of future combat.

References:

Ajey Lele. “Role of Nanotechnology in Defence.” *Strategic Analysis*, vol. 33, no. 2, Mar. 2009, pp. 229–241.

Altmann, Jürgen. “Military Uses of Nanotechnology: Perspectives and Concerns.” *Security Dialogue*, vol. 35, no. 1, 2004, pp. 61–79.

Amit Kumar. “Nanotechnology Development in India An Overview.” Http://Ris.org.in/Images/RIS_images/Pdf/DP 193 Amit Kumar.pdf.

Beumer, K., and S. Bhattacharya. “Emerging Technologies in India: Developments, Debates and Silences about Nanotechnology.” *Science and Public Policy*, vol. 40, no. 5, 2013, pp. 628–643.

Defense Nanotechnology Research and Development Program.” Https://Www.nano.gov/Sites/Default/Files/pub_resource/Dod-report_to_congress_final_1mar10.Pdf.

JOTS v41n1 - Military and National Security Implications Of Nanotechnology.” ALAN v37n3 - "The Best of Both Worlds": Rethinking the Literary Merit of Graphic Novels, Digital Library and Archives of the Virginia Tech University Libraries, scholar.lib.vt.edu/ejournals/JOTS/v41/v41n1/tate.html.

Kosal, and E. Margaret. “Military Applications of Nanotechnology: Implications for Strategic Security I.” Https://Calhoun.nps.edu/Bitstream/Handle/10945/45129/KOSAL_PASCC Rev Final.pdf;Sequence=1.

Nanotechnology for Defence Applications.” Https://Www.drdo.gov.in/Drdo/Pub/Nl/2012/NL_November_2012_web.Pdf.

Nanotechnology in the Military.” Http://Ice.chem.wisc.edu/Small Science/From_Small_Science_Comes_Big_Decisions/Choices_files/Military.pdf.

NEVE, ALAIN DE. “Military Uses of Nanotechnology and Converging Technologies: Trends and Future Impacts.” Http://Www.irsd.be/Website/Images/Livres/Focuspaper/FP08.Pdf.

Ramsden, Jeremy J. “Nanotechnology for Military Applications.” *Nanotechnology Perceptions*, vol. 8, no. 2, 2012, pp. 99–131.

Sanjiv Tomar. “Nanotechnology Current Global Trends and Future Military Applications for ‘Soldier as a System.’” *Journal of Defence Studies*, vol. 8, no. 4, Dec. 2014, pp. 55–82.

Sujit Bhattacharya. “Nanotechnology Research and Innovation in India: Drawing Insights from Bibliometric and Innovation Indicators.” Http://Www.nistads.res.in/Images/Bulletin/nano2.Pdf.