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Nano and thin film technology in missiles

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Abstract
The aim of the work is to focus on how Nanotechnology and Thin Film Technology plays an important role in Missiles. And also it focuses on the design of smart control surface for micro air vehicles, actuators & sensors etc.
Nanotechnology and Thin Film Technology is an emerging field which can lead to the development of new weapon systems and products that can benefit our nation. It is recognized as a very strong innovation driver, therefore seen as a strategic technology for the future economy including Defence and security.
It will enable small portable sensor system capable of identifying Chemical, Biological, Nuclear, Radiation or Explosive threats etc.
The objective is to report fundamental and applied research in Modelling, analysis and designing with smart application for lateral vehicle. In Thin Film Technology, Optical thin film elements and high efficiency anti-reflection coating for night vision plays a vital role in Defence Organisation.
My main focus on this paper is to establish a New and well developed research network in defence sector and building better products for Defence forces with enabling technologies using Nano and Thin Film Technology application with outstanding combination of Mechanical, Thermal, Physical and Optical properties.

Keywords: Nanotechnology, Thin Film technology, Nanofabrics, Optical coating, sensors

Introduction
Nanotechnology and Thin Film technology is referred as the new and advanced technology through which humans extend their ability of understanding and harnessing the nature to the atomic and molecular levels by direct control and manipulation of atoms, molecules, clusters, causing them to recombine, rearrange, to form new substances under microscopic conditions. Both Nano and Thin Film technology plays an important role in missiles and in defence organisation, for the development of major domains such as Nano sensors, artillery, nanotubes, transports and submarine, hazard detection and prevention etc. It is now centered stage for highly competitive and technological developments in the world. It is a major driving force in a new age to bring a drastic and widespread changes to the macro world through control and manipulation of defence environment.
Many countries have acquired results in Nanotechnology and Thin Film, Research and development that attract peoples' attention towards these techniques. The aim of the work is to provide an idea at mainstream technology in the 21st century, which certainly initiate a new industrial as well as missiles and research revolution in the world with authentic information on technology, economic impacts, and regulatory mechanism in civil as well as military sectors.

Nanotechnology and Thin Film technology – A Review
Nanotechnology is the branch of technology that deals with dimensions and tolerances of less than 100 nanometers, especially the manipulation of individual atoms and molecules.
Thin Film is the technology of applying a very Thin Film of material between a few nanometers to about 100 micrometers or thickness of a few atoms onto a substrate coated to form layers on deposition.

History
Although nanotechnology and Thin Film technology is a fairly new science, the chide concepts have been developing over the course of 50 years. Interestingly employing nano and Thin Film technology for over a thousand years, from painting to making steels. Although, it has changed in our ability to manipulate in nanometer scale and Thin Film coating. One of the example used in medieval period is:

- **Medieval Stained Glass**

One of the most documented example of nanotechnology and Thin Film technology known in history is 'medieval stained glass' artisans. They were the first technology used with trapped gold nanoparticles in 'glass matrix' in order to generate the ruby red color in the windows. They also trapped silver nanoparticles which gave it a deep yellow color. As in today's findings, it is the size of metal that defines the variation in color and sizes with Thin Film coating. This example of color change is a testimony to the dramatic change in material properties at the nanoscale as well as Film coating.

Statement of the problem
Although the 'nanoboom' could contribute a lot to the society as well as to defence areas, there are several health risks involved with using nanoparticles. The study of toxicity in nanomaterials is called 'nanotoxicology'. There has been a lot of research into the risk of using nanotechnology, which quoted as follows:
Nanopollutants are a current risk to the general population, but especially to workers in research and developments. Nanopollutants are very simply small nanoparticles, which is enough to enter the skin and be absorbed by the lungs and maybe able to cross the blood brain barrier which cause severe damage to brain.

So working with nanopollutant should be considered severely and prior handlings should take before indulging into the missile work for filling fuels at vehicles, as all fuels contains some contaminations which be noticed regularly to avoid such circumstances.

Nanotechnology and Thin Film technology development is progressing very rapidly, several billions of dollars have been invested in nanoscience research. Pioneering research efforts have been primarily conducted at research institutions and centres. This paper identifies developments in nanoscience and technology that could provide significant advances in missile system applications. Nanotechnology offers opportunities in the areas of advanced materials for coatings, including Thin Film optical coatings, light weight strong armor, and missile structural components, embedded computing and smart structures, nanoparticles for explosive, turbine engine system and propellants to enhance missile propulsion and nanotube arrays for fuel storage and power generation.

The Aviation and Missile Research Development and Engineering Center (AMRDEC) is actively collaborating with academia industry and other government agencies to accelerate the development and transition of nanotechnology to favourably impact Army transformation. Combining Micro Electro Mechanical Systems (MEMS) and nanotechnology is the next step towards providing a technical solutions for AMRDEC in transforming research and development projects.

Thin Film technology also plays an important role in high tech industries. Thin Film has been developed primarily for need of integrated industry such as defence, space and information technology etc. The demand for development of smaller and smaller devices with higher speed especially in new generation of advanced materials and processing techniques suitable for future Giga Scale Integration (GSI). In this regard physics and technology plays an important role to achieve this goal. The production of Thin Film for device purpose has been developed over past 4 decades.

It acts as a two dimensional system which are of great importance to many real world problems. Their material costs are very small as compared to surface process. Thin Film technology is based on 3 foundations: Fabrications, Characterization and Applications. Some of the important application of Thin Film are microelectronics, communication, optical electronics and energy generation and conservation strategies in all sectors.

Objectives

The main objectives of this paper is to provide:

1. To achieve a higher performance platforms in military, Nanofabrics and Liquid Body Armour etc.
2. To enhance human and sensor performance in improvising devices like military and defence optics, laser limiters and target discrimination etc.
3. To fabricate high performance Thin Film coatings for high reflecting mirrors, radiation hardened mirrors and image intensifiers.
4. To aspire to be a center of excellence in Thin Film research such as photon detectors laser finding and tracking applications, surveillance.

Major Applications of Nanotechnology and Thin Film technology

Nanotechnology is used in several areas all over the areas which includes

Electronics industry	Medical fields	Automobile industry
Pharmaceuticals including drug delivery, cosmetics, among others	Materials science including textiles, polymers, packaging, among other	Environmental monitoring and control
Biotechnology	Sports equipment	Optoelectronics
Forensics	Food science: quality / packaging	Aerospace industry
Military	National security	University and federal lab research

Applications of Nanotechnology and Thin Film technology: Engineering/Processing

- Tribological Applications like Protective coatings etc.
- Low friction coatings
- Hard coatings for cutting tools
- Lightweight containers
- Shock-absorbing materials
- Alarm for mechanical deficiencies
- GPS trackers
- Artificial electronic nose to detect gases
- Protection against high temperature corrosion
- Self-supporting coatings of refractory metals for rocket nozzles, crucibles, pipes
- Decorative and catalysing coatings

Progression of Nanotechnology

Nanotechnology has begun to blossom in the last few decades with military and Liquid Armour Body, this is largely due to the development of new instruments that allow researchers to observe and manipulate matter at the Nanolevel. Technologies such as scanning tunneling microscopy, magnetic force microscopy, and electron microscopy allow scientists to observe events at the atomic level. At the same time, economic pressures in the electronics industry have forced the development of new lithographic techniques that continue the steady reduction in feature size and cost, which helps to identify any small objects even at night time with high accuracy. Just as Galileo's, knowledge was limited by the technology of his day, until recently a lack of good instrumentation prevented scientists from gaining more knowledge of the Nanoscale. As better instrumentation for observing, manipulating and measuring events at this scale are developed, further advances in our understanding and ability will occur.

Military

From Europe to Asia, all major world powers are now investing and researching into the use of nanotechnology for materials and systems for military use. The U.S. Department of Defence spending billions of dollars towards military sector. The Institute for Soldier Nanotechnologies (ISN) are in way of developing and taking advantage of nanotechnology to help soldier to survive in battle conditions. The jumpsuits made of nanofabrics style to react more efficient and light weight.

Nanofabrics

Nanofabrics are currently being researched for use in military camouflage. A development called 'active camouflage' allows the wearer to blend into its surroundings. It uses panels and

coatings that can change their appearance, from luminance and reflective properties to color. This technology is perfect for military purposes as it provides complete concealment from visual detection.

Liquid Body Armour

Another development courtesy of nanotechnology is primarily used for military and protection purposes is 'Liquid Body Armour' in Kevlar vests. Under normal conditions the new vest acts in a similar way to water, providing adequate protection. The key component in the vest is 'shear thickening fluid' with strong properties. It is composed of hard particles, which are suspended in a liquid form. Nanoparticles of silica are highly important to the chemical make of this solution. The combination of hard kevlar and flow able STF components results in a material that is suitable for future soldier. Liquid Body Armour gives the wearer an impact resistant vest from bullet damage to pointed objects such as swords, riffles etc.

Progression of Thin Film technology

Thin Film technology is intended to provide an overview of design and development of Thin Films and protection of material from coatings etc. This technique includes coating requirements and designing for high powers in Thin Film which is employed in military and civil sectors.

Thin Film Coatings

Optical coating for military applications needs to simultaneously satisfy many extreme requirements, who have responded with an array of design and fabrication and approaches. Optical coating for military applications revolves exceptional optical performance in harsh environment. These can include high laser damage threshold wide angular acceptance, large swings in temperature and humidity with good mechanical durability.

- **Coating requirements**

The demanding requirements of designator is to both design and fabrication of their Thin Film coatings. It is particularly difficult to design coatings that function in the 1064nm while simultaneously operating in mid-IR. This is because there are few coating material that work well over both these widely spaced wavelength bands. Designing such coatings becomes even more challenging when large angular range and multi spectral operation is combined with tight specifications for polarization insensitivity.

Designing for High power coating

For applications with laser beam intensities, managing laser damage threshold is critical and requires both careful design and good metrology. Producing optical coatings for military applications is a unique challenge, as these coatings accommodating more factors that are typically encountered for commercial applications. Moreover, no single coating method is ideal for all military applications, it is best to work with a versatile supplier who has access to a comprehensive suite of deposition and metrology capabilities.

Military & Defence optics

The highest performing anti-reflection coating in the visible through long wave infrared spectral bands. To design, manufacture and test multi IR filter coatings. Combination of materials and variable coatings to produce unique variable spectral performance filters including detection and jamming which is employed in Infrared. New infrared technology can detect minute details at distances of over 100 meter.

Photon detection

Infrared imaging utilizing photon detectors typically operate in spectral bands. Photons from light are gathered through an objective lens which focuses the photons to a cooled detector. Since every photon counts, high performance anti-reflection coatings on lens are needed to increase overall transmission and detection.

Surveillance

Surveillance is the act of monitoring the behavior of people in local or remote locations. Markets for this technology includes Marine Surveillance, military law Enforcement etc. This Thin Film technology supplies visible and infrared elements to systems.

Conclusion

It is found that this work will enhance many new techniques in nano and Thin Film technology and also more number of equipments should be discovered with great effort. These techniques should be employed by all sector in order to develop our nation in many emerging fields like economic, space, biomedical, research organization. However above mentioned contents is also employed in the subjects, if it is implemented by the respective organizations it will benefit for the future deeds, to overcome the problems which were facing in our today's generation.

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