Declining Electrical Problems via Nanotechnology

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***Abstract* — In today's world, the development of any nation in the world depends on a great extent on the availability and usage of energy. It is thus natural that we would be utilizing the available energy for industrial production, commercial activities, urban & rural development and personal requirements. The vast bulk of the energy used on the world today is in the form of non-renewable oil, natural gas and coal. Use of energy efficient equipment and equipments of correct size, refurbishing of products in operation, switching off the electricity when not needed are some of the simple methods which saves energy. Conservation of electrical energy means the reduction in energy consumption but without making any sacrifice of quantity and quality of production. Nanotechnology is one of the leading edge techniques of today impact. It is an advanced material engineering and use of this technology for obtaining the solution of engineering problems facing by the electrical system. This paper describes about the various remedial measures for problems of complete electrical system through nanotechnology.**

***Keywords*— Conservation, Consumption, Electrical System, Energy Efficiency, Nanotechnology**

1. INTRODUCTION

Nanotechnology is one of leading method of today. In fact it is an advanced material engineering. Nanotechnology could affect us beyond nanoparticles, length scales and nanotools. The word "Nano" a Greek word which means "drawf" and it means 10-9 meters. Nanotechnology has been come out from the field of science called as "Nanoscience", which means study of phenomenon of materials of atomic, molecular and macromolecular scales, where properties differ significantly from other big size matters/ materials, as bulk materials possess different physical properties (such as colour, appearance, electrical, mechanical, chemical, optical properties) than very different from the properties of same materials at the macro scale. Globally, nanotechnology is defined as the design, characterization, production, manufacturing and uses of structures, devices, tools, machines and systems by controlling shape and size at the nanometer scale. In doing this, nanoscience and nanotechnology deal with atoms of 1nm in one dimension and principles of classical physics are no longer applied to these structures. Thus, the materials formed are as nanostructured materials/nanostructures, such as nanoporous, nanocrystalline, nanocomposite and hybrid materials.

2. PROBLEMS FACED BY ELECTRICAL SYSTEM

As the electrical system is broadly categorised into four main backbones namely generation, transmission, distribution and utilization. Each plays a vital role in the socio-economic and technological development of every nation. Many countries including our nation facing acute shortage of electrical power problem, which are main root cause for its development. The main reasons for shortage of electrical power are inadequate generation capacity, high auxiliary power in power stations, low efficiency of generating plants, ageing performance deterioration of old plants, high ash content in Indian coal leading of problems of disposal, pollution and erosion

of plant components [1], thus a lot of release of huge amount of environmental polluting substances and many GHGs.

3. POINTS TO REDUCE POLLUTING SUBSTANCES [2-3]

Enormous reduction of polluting substance emissions can be possible by the:

- Improvement of energy conversion efficiency at the different stages.
- Improved applications of electrical and fossil fuels energy.
- Innovative technologies that are highly energy efficient such as High Temperature Superconductors etc.
- Reduction of electrical and fossil fuels losses in rotor dynamic machines (turbines, compressors, heavy pumps, motors, generators etc.).
- Use of energy efficient and ultra sensitive electronic devices, magnets, fault current limiters, detectors, superconducting quantum interference devices, transmitters etc.
- Reduction in power T&D losses.
- Proper operation and maintenance criteria.
- Design modification to improve energy conversion efficiency.
- Up-gradation of technology and increasing the energy efficiency of equipments.

Selection of alternative energy fuels such as bio-diesel, fuel cells, solar cell, hydrogen energy, gasohol, ethanol etc. and other renewable energies.

4. REMEDIAL MEASURES VIA NANOTECHNOLOGY

4.1 Nanotech Solar cells for Electricity generation

Nanotech solar cell is unique for both energy efficiency and cost value. It is achieved by depositing a thin-film of copper indium-gallium di-selenide CIGS-based PV cells to create an efficient, adequate, durable solar cell. This semiconductor was 100-200 times thinner than silicon wafer used for other semiconductor applications and punching & printing process is 10 times faster than the conventional thin-film process of high-vacuum deposition. As per laboratory experimentations, the CIGS cell has conversion rate of about 20-21 percent from sunlight to electricity and far superior and even better than most crystalline silicon technology. Also using nano CIGS solar cell size is about 20 percent reduces and cost of manufacturing is much greater than that of thin-film cells.

Other nano-substances such as nano-crystals namely high performance nano dots and nano tube arrays have remarkable effects in the field of electricity generation using nano-cells. High performance semiconductor nano-crystals (nano dots) that is active over the entire visible spectrum and also into the nearly infrared region to produce ultrahigh-performance solar cells. High ordered solar tube arrays have remarkable properties used in solar cells. As per researchers, these materials produce “electron highway” for directing the photo-generated electrons for useful work.

4.2 Nano-Transmission

Transmission of electrical power is another focus agenda of the Electrical system of any nation. A good power reached at the end user is only possible by better transmission methods. High temperature superconductors power cables and wires are now-a-days suitable era and are highly capable to wear large current density under cryogenic conditions (77^0K) with zero resistance, low impedance, zero electromagnetic radiation and free from hazardous cooling oil than conventional power cables and wires [4]. Nanotechnology will also helpful to improve the efficiency of transmission sector of the nations. There are variety of nano-materials and other nano-related applications related to field of electrical power transmission. ACSR

(Aluminium conductor with steel reinforced) conductor is the standard overhead conductor in our nation [5], whereas Carbon nanotubes are one such nano material which has a potential to improve the power transmission in our country. A carbon nano-tube (CNT) us a type of fullerene (Carbon-only) material that is formed by atoms of carbon link together in spherical shape. A single walled CNT exhibits high electrical conductivity more than 10 times than copper and possessing flexibility, elasticity, tensile strength as well as have a potential to fibred into wires and cables. Nanotechnology applications will also help to improve the components of electric power transmission components such as transformers, insulators and sensors.

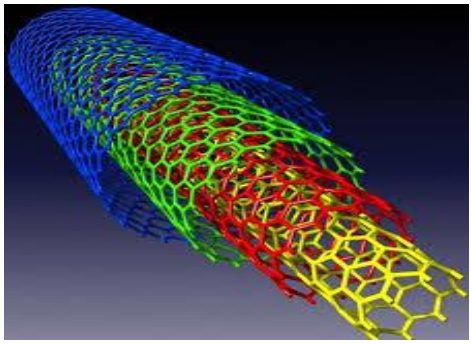

Fig. 1 Carbon Nanotubes

4.3 Nano-Transformers

Transformers play a vital role in electrical power system to transfer the power at different voltage level to achieve the maximum efficiency of power transmission. Due requirement of high voltage insulation and better cooling requirements in transformers leads to extensive research work aiming at high dielectric strength and cooling conditions. So, aiming on these requirements, dielectric nanofluids (NFs) has been developed. These fluids are prepared by adding nano-particles suspension to transformer oil, thus dielectric strength and thermal characteristics of transformer oil improved. Nano-particles increase heat transfer and solid nano-particles conduct heat better than liquid and these particles suspended in liquids better than larger particles and thus heat transfer is better and easy. Furthermore, use of nano-particles in high temperature superconductors (HTSrs), efficiency of transformers improves with no flammability and increase in flexibility [6].

4.4 Sensors

Power transformers have a considerable service life of 25-30 years leading to conditional monitoring of operation and metering of transformers in the field. But when they fail prematurely, the result is a dangerous explosion. One of key point of the premature failure of device is deterioration of transformer oil and level of hydrogen gas, which is analysing by gas chromatography. So, it is necessary to monitor levels of hydrogen gas in the insulating oil. Applied Nanotech Inc has created a palladium alloy nanoparticles sensor that is as small as a square millimetre. This sensor can offer continual monitoring of hydrogen gas in transformer oil at levels as small as 4 parts of million. The devices work by the expansion and contraction of palladium alloy particles within a dielectric substrate. It acts as a switch, turned on as that expands when in contact with hydrogen.

Nano-electronics have revolutionized the variety of sensors and power control devices which as self-calibrated and self-diagnosing. Such sensors also allow for remote monitoring of infrastructure as real-time basis.

4.5 Insulators

Insulators play a vital role especially in field of high power transmission beyond the level of 132kV i.e. 132kV, 220kV, 400kV, 765kV & 1500kV & in order to provide suitable protections in these extra-high voltages, suitable arrangements are made. However, fabrication of nano-structured hydrophobic coating on the surface of insulators reduce the flash-over phenomenon in high power transmission.

4.6 Nano Batteries

Nanotechnology plays a great role in distributed generation and substation through

development of cost effective energy storage batteries and capacitors. Carbon nano-tubes (CNTs) have high surface area, good conductivity & have a good geometry make them suitable for battery accessibility through electrolyte. Due to these characteristics of electrolytes, increase generation efficiency as compared to traditional electrolytes. Thus, smaller n lighter with more powerful batteries can be manufactured with this technology.

4.7 Supercapacitors

Capacitors helps in electrical power system to transfer more power from source to end point with improvement in power factor of system. Electrolytic capacitors are now-a-days are used to more power applications of the order of few microfarads to hundreds of microfarads, arranging themselves in series or parallel to obtain successful power transfer from one point to another point. These are very helpful in doing power transfer but costlier method, it is. So, due to fast charge and discharge capabilities over hundreds of thousands of cycles, supercapacitors serve a wide range of commercial power storage applications, including regenerative braking systems in railways, load levelling and hybrid electric vehicles as well as utility grids.

Applied Nano-structured Solutions (ANS) is set to enable supercapacitors with significant improvements in their performance such as improvement in capacitance by approximate 200percent. The other supercapacitors are Carbon nanostructures (CNS) like paper-CNS supercapacitor material works in both organic and aqueous solutions. Fig. 2 shows supercapacitor of 1Farad (One Farad) already available in market to do the needful work.

5. CONCLUSION

Nanotechnology holds a lot or promises in terms of applications and products developments in wide range of science & technology and thus, in electrical system, in order to plug the nanotechnology solutions in electricity sector, basic requirement is to have the complete knowledge of power system and problems faced by the power system too. Through this paper, an attempt has been made to focus on this technology and found appropriate solutions via nanotechnology and possible adaptation of nanotechnology in field of electricity generation. Also, the researchers should work more on this new profitable technology that is useful in many faces of the country.

Fig. 2: Supercapacitor (1 Farad)

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