

# Role of synthesis and characterization Techniques of nanostructures for the development of nano technology and sustainable environment

<sup>1</sup>G. Sri Devi, <sup>2</sup>Sandhya Cole

<sup>1</sup>Dept.of Physics, Acharya Nagarjuna University, Nagarjuna Nagar, A.P., INDIA

<sup>2</sup>Dept.of Physics, PVP Siddhartha Institute of Technology, Vijayawada, A.P., INDIA

<sup>2</sup>*sandhya.cole@gmail.com*

**Abstract** - Nowadays Nanoscience and Nanotechnology play an important role to increase The efficiency of energy storage devices due to their size-dependent properties. Materials with nanometer size of small dimensions can exhibit high chemical, electrical, optical, mechanical thermal properties. Synthesis of nanoparticles with various techniques plays the key role to control The morphology, size, structure of nanoparticles to produce different nanostructures in various dimensions like quantum dots, nanotubes, nanowires, nano belts to meet the industrial requirement to enhance the efficiency of optoelectronic devices.

**Keywords** —Nanoscience, Nanotechnology, Synthesis techniques, morphology, optoelectronic devices.

## I. INTRODUCTION

Nano means small size ranges between 1nm and 100nm. Due to the reduction of a size of particles into Nano level, they exhibit novel properties when compared to bulk materials. Nanoparticles create a great interest in researchers due to their small size, they can exhibit large surface area to volume ratio, quantum confinement effect which changes dramatically their physical, chemical, magnetic, electrical, optical properties. In recent years production of Nano particles with various nanostructures plays a challenging role for the scientists in their Basic science and technical and industrial research activity. Various techniques have been developed to fabricate nanostructures such as ball milling, plasma arcing, sol-gel, chemical precipitation methods, hydrothermal synthesis, chemical vapor deposition biological synthesis using Bacteria, fungi. Nanotechnology and Nanoscience is multidisciplinary research activity to enhance the industry requirements to fabricate Nanoscale devices to improve The efficiency of photovoltaic cells, sensors, lasers, fuel cells, photo detectors, Energy storage device, superconductors, bio medical devices. Nanoparticles show excellent applications in different fields of life.

In this paper, we discussed properties of nano materials and fabrication techniques to control size, structure, morphology of Nanoparticles and importance of characterization techniques to analyze Nanoparticles and the advantages of nanostructures for the sustainable environment.

## II. IMPORTANCE OF NANOMATERIALS

Nano materials exhibit Two basic principles

1. The increased surface area to volume ratio
2. quantum confinement effect

Due to this nano materials differ from the bulk material. Nano materials exhibit large surface area to volume ratio due to this no of atoms occupation in the surface sites increases and the interatomic distance between the atoms decreases and the bonding force increases between the atoms strength of material should increase it represents the change in size and structural properties of bulk materials. Nano materials exhibits efficient physical, chemical properties. Another important aspect is quantum confinement effect. Nano particles how quantum confinement effect which changes optical, electrical properties in a remarkable manner.

## III. FABRICATION TECHNIQUES

To Synthesize nanoparticles in an effective manner fabrication techniques plays a vital role. during synthesis, we can control the size, structure, and morphology of particles and produce different forms of nanostructures which fulfill the industry requirement.

Generally, there is two basic method to produce nanoscale particles.

- Top-down method
- Bottom-up method.

**TOP-DOWN METHOD:** In this method, we can produce large Scale structure particles into small-scale structures.

- \*Ball-milling
- \*Erosion

### Bottom-up method:

In this method, we produce material atom by atom molecule by molecule.

- \*plasma arcing method
- \*Chemical vapor deposition method
- \*Hydrothermal method

**sol-gel method** with these methods, we can control the size of particles decrease agglomeration between particles and produce narrow particles size, uniform distribution.

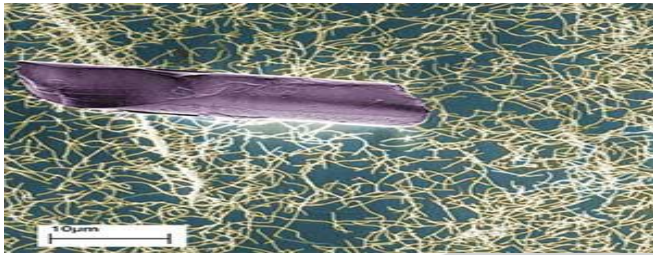


Fig:1 it is the picture of human hair which is 80,000nm range

## IV. CHARACTERIZATION TECHNIQUES

To analyze the samples characterization techniques are most important depending upon this we utilize.

X-Ray diffraction describes the structure of crystalline material and size, dislocation density and identifies phase compositions of the sample. where  $\lambda$  is the wavelength of X-ray diffraction,  $\beta$  is FWHM in radians of the XRD peak,  $\theta$  is the angle of diffraction.

From the Full Width at Half Maximum (FWHM) of the lattice strain induced in sample is also calculated from Stokes-Wilson equation  $\epsilon = \beta / 4 \tan \theta$

The dislocation density ( $\delta$ ) is also estimated from the crystalline size and is given by

$$\text{Williamson-Stallman relation } \delta = 1/D^2$$

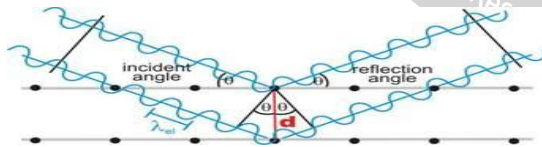
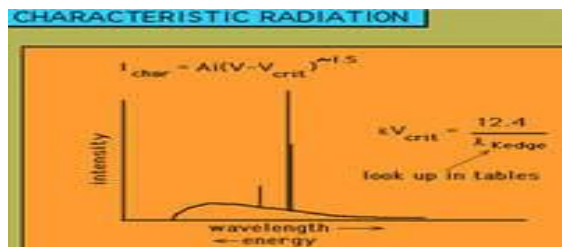


Fig.2 diffraction of x-rays



Schematic representation of size, structure evaluation potential applications for energy savings:

Nanoparticles possess excellent application in a different

field due to their enormous physical, electrical, mechanical, magnetic, optical properties.

\*Nano semiconducting compounds show quantum confinement effect quantum dots we can increase the efficiency of solar cells by using these semiconducting quantum dots as a window layer.

\*Nano carbon tubes (CNTs) are used in making vehicles and airplanes light in weight to reduce fuel consumption.

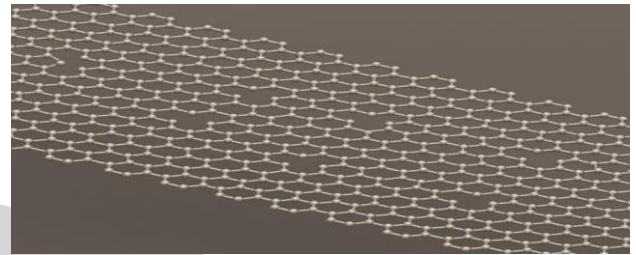


Fig. 2 carbon nanotube structure

\*\*Nano drugs and medicines are also a great impact in orthopedic implants and heart valves due to small size more efficient.

\* Low-cost panel display devices enhanced by replacing with nanocrystalline phosphorus.

\* Magnets made with nanocrystals act as high power magnets which are used in submarines, automobile generators, and manufacturing of bio-medical instruments.

\*For the development of quantum computers, quantum chips play a vital role.

\* Nano semiconducting tubes can store hydrogen.

\*Metal ionic nanoparticles are used in battery devices to improve efficiency.

## V. CONCLUSIONS

In this paper we discussed the importance of Nanotechnology, effective role synthesized techniques, properties, and applications of nanoparticles for the industry requirement to fabricate Nano scale devices to improve the efficiency of optoelectronic devices for a sustainable environment.

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