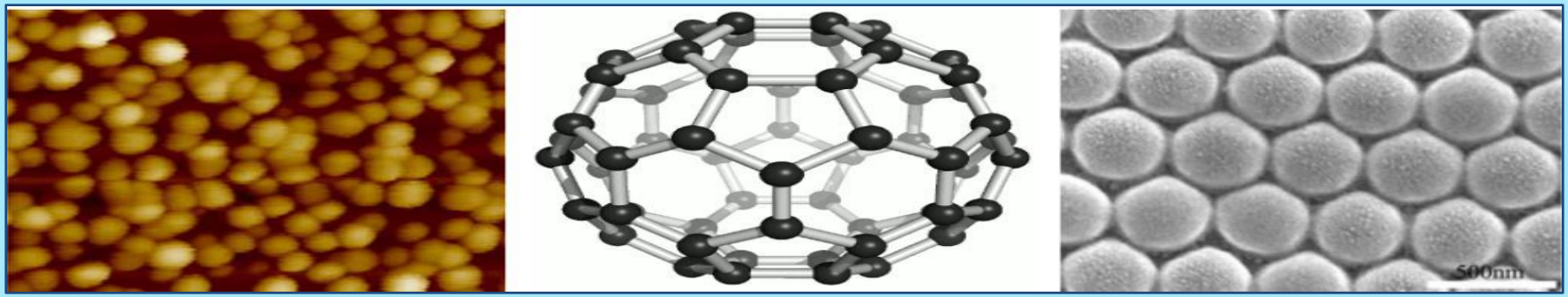
S.O.S. IN ENVIRONMENTAL CHEMISTRY
JIWAJI UNIVERSITY, GWALIOR(M.P.)

NANOTECHNOLOGY

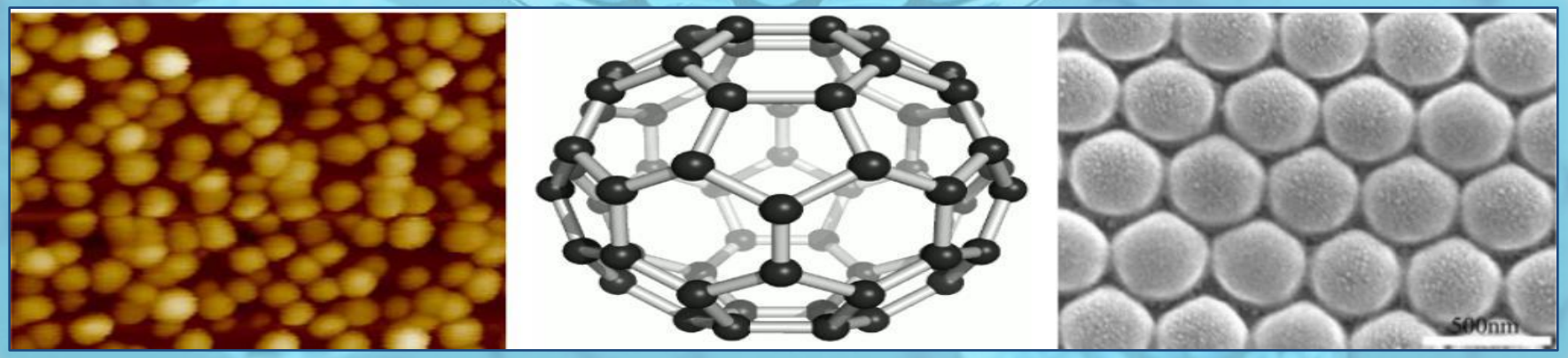


INTRODUCTION

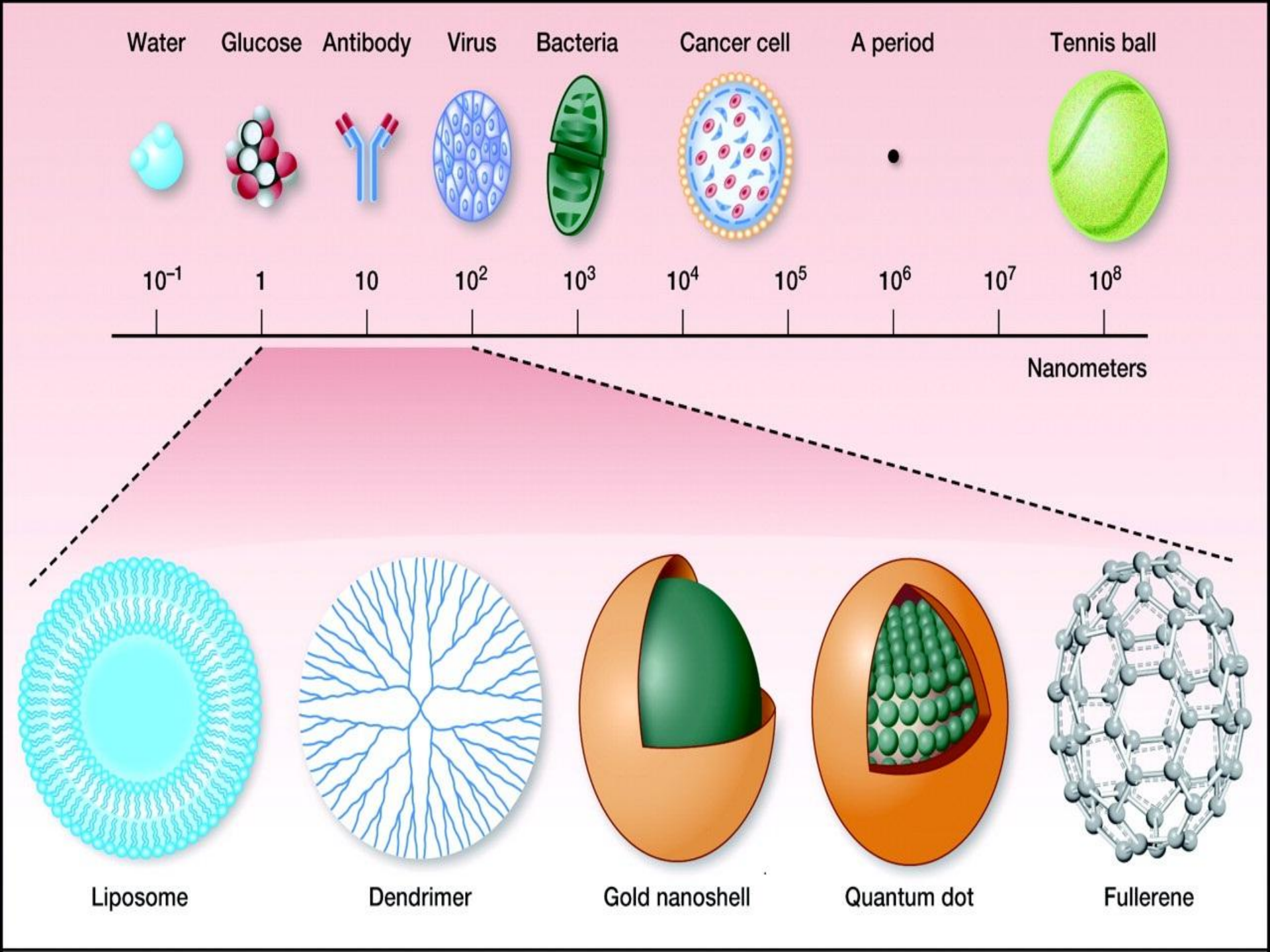
Nanoscience and nanotechnology primarily deal with the synthesis, characterization, exploration, and exploitation of nanostructure materials.

Nanoparticles are particles ranging in size from approximately 0.1 micrometer (100 nanometers) to .001 micrometers (1 nanometer).

Nanomaterials are materials with one or more external dimensions, or an internal structure, on the nanoscale, which could exhibit novel characteristics compared to the same material without nanoscale features.



Au nanoparticles *Buckminsterfullerene* *FePt nanosphere*


Water
Glucose
Antibody
Virus
Bacteria
Cancer cell
A period
Tennis ball
10^{-1}
1
10
10^{2}
10^{3}
10^{4}
10^{5}
10^{6}
10^{7}
10^{8}
Nanometers
Liposome
Dendrimer
Gold nanoshell
Quantum dot
Fullerene

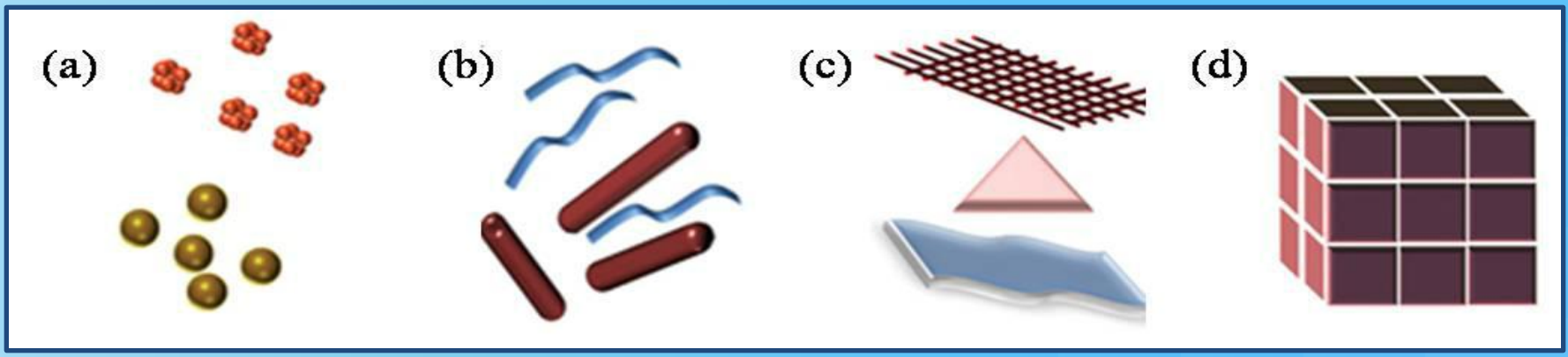
Classification of Nanomaterials

a) 0D spheres and clusters

b) 1D nanofibres, wires and rods

c)2D films, plates, and networks

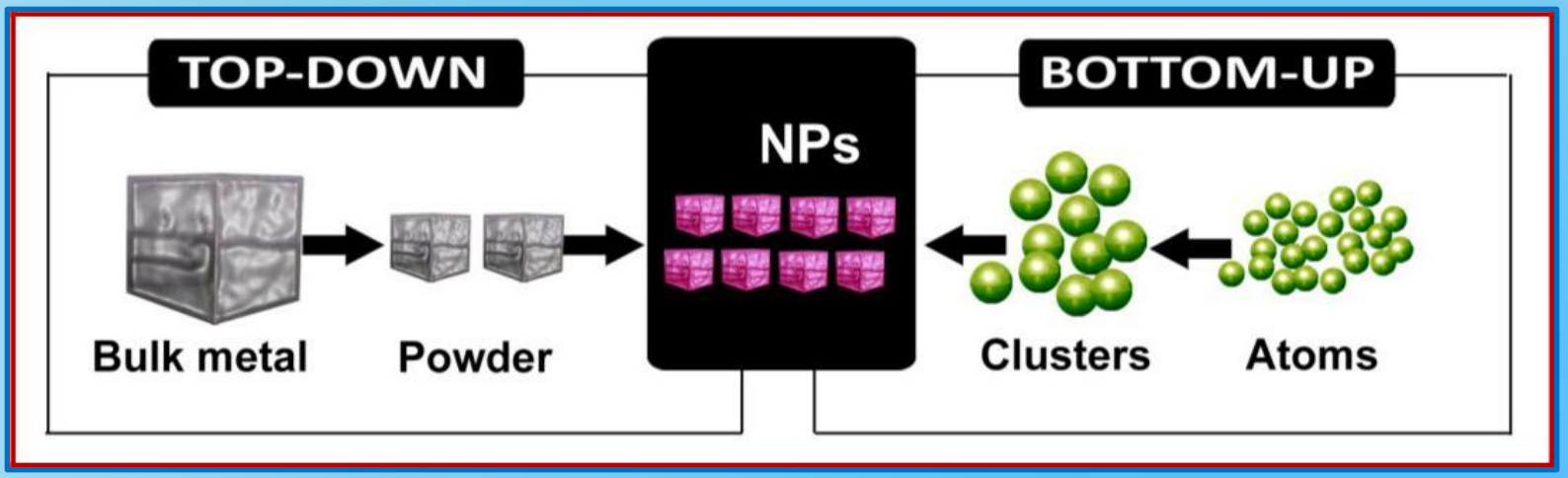
d) 3D nanomaterials.



Nanoparticle Synthesis

Top-Down approach

Bottom-Up approach



Top down approach refers to slicing or successive cutting of a bulk material to get nano sized particle.

Bottom up approach refers to the build up of a material from the bottom: atom by atom, molecule by molecule.

Properties of nanomaterials:

- Surface Plasmon resonance
- Magnetic properties
- Mechanical properties
- Electrical Conductivity
- Optical properties

Methods for synthesis nanostructures:

1. Mechanical grinding
2. Sol-gel process
3. Wet Chemical Synthesis of Nanomaterials
4. Gas Phase synthesis of nanomaterials
5. Sputtered Plasma Processing
6. Particle precipitation aided CVD
7. Laser ablation

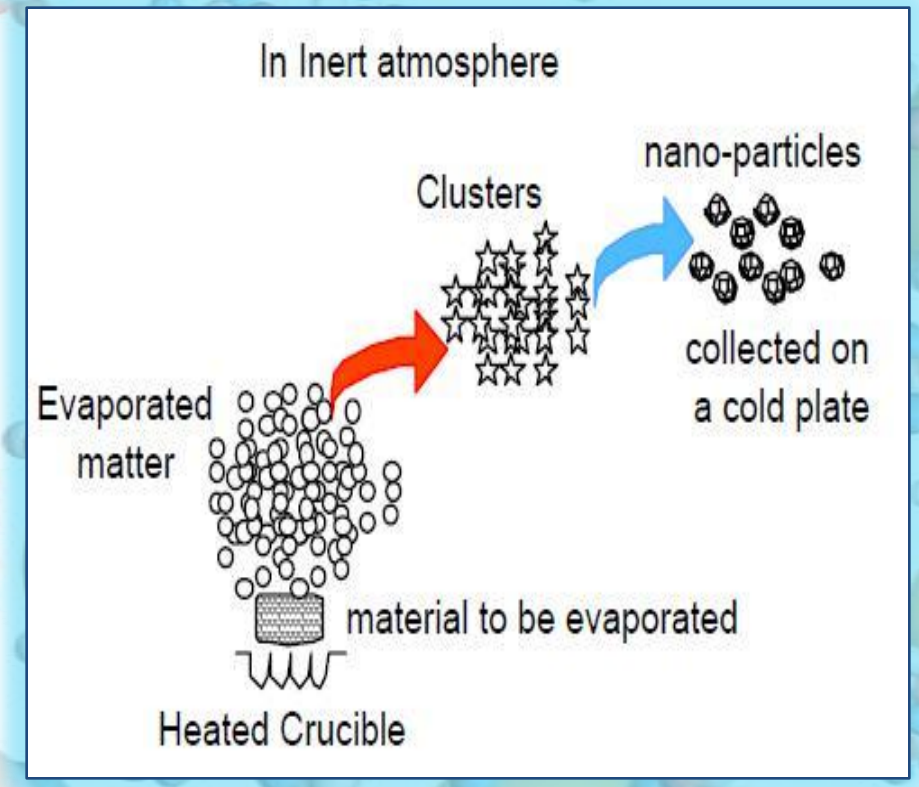


Fig. gas phase process

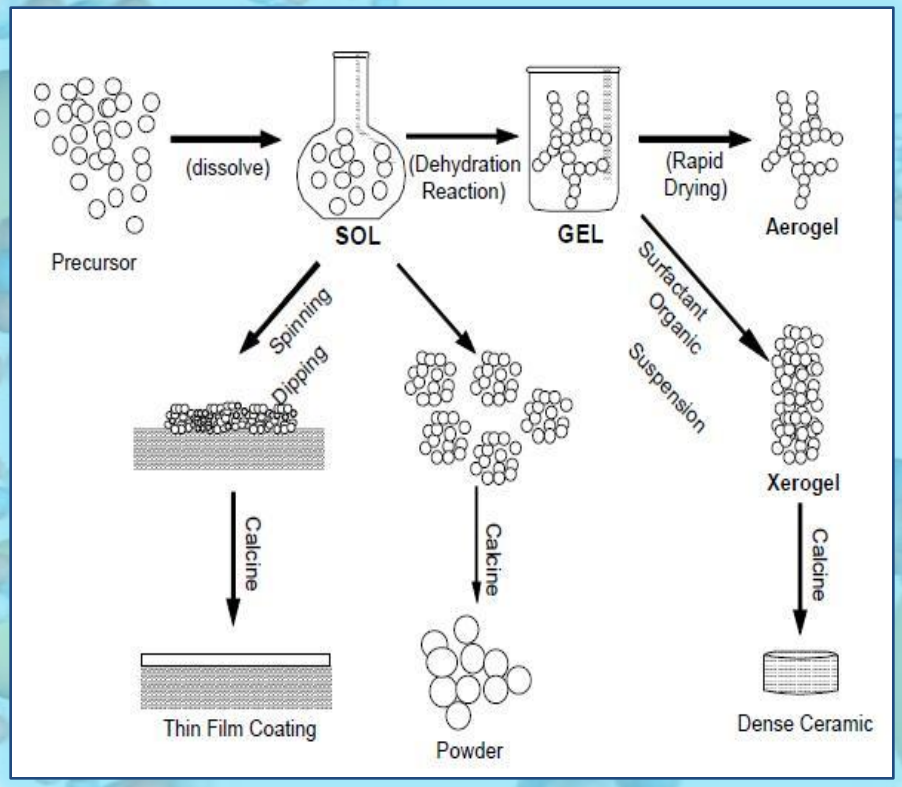


Fig. sol-gel process

Characterization

- X-ray diffraction (XRD)
- Transmission electron microscopy (TEM)
- Scanning electron microscopy (SEM)
- Scanning tunneling microscopy (STM)
- Atomic force microscopy (AFM)

Applications of Nanotechnology

The potential applications of nanotechnology in different fields are the following:

I. Electronics

- Improving display screens on electronics devices.
- Increasing the density of memory chips
- Reducing the size of transistors used in integrated circuits

II. Health and Medicine

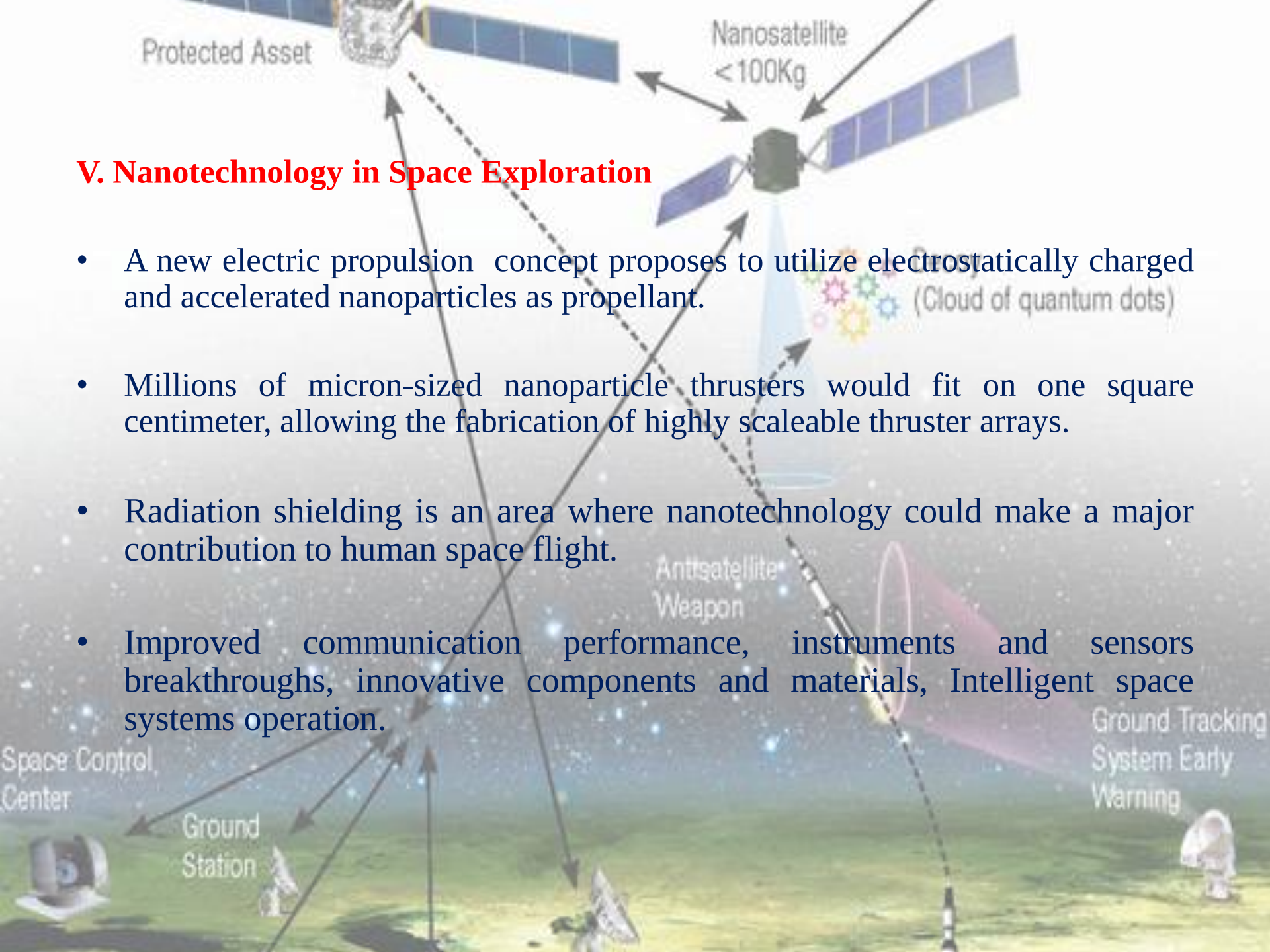
- Nanomedicine has the potential to enable early detection and prevention, and to essentially improve diagnosis, treatment and follow-up of diseases.
- Biological tests measuring the presence or activity of selected substances .
- Nanodevices can make gene sequencing more efficient.
- Nanotechnology can help to reproduce or to repair damaged tissue.

III. Transportation

- Nanotechnology will enhance aerospace application and space flight as new materials will allow space shuttles to become lighter and tougher.
- Nanotechnologies has recently released an air filter, which uses nanotechnology principles, to remove hazardous chemicals from the air in car cabins .
- Improved catalysts could reduce or eliminate the emission of pollutants from engines .
- Nanocoating of metallic surfaces to achieve super-hardening, low friction, and enhanced corrosion protection .
- Introducing the nanoparticles reduces fuel deposits on pistons and cylinders, increasing fuel efficiency by about 10% .
- Nanoparticles of inorganic clays and polymers will replace carbon black tires and therefore we will have environmental friendly, wear resistant tires

IV. Nanotechnology, Energy and Environment

- Nanotechnology is having on renewal energies, from solar technology, to nano-catalysis, fuel cells and hydrogen technology.
- Carbon nanotube fuel cells are being used to store hydrogen. These are the environmentally friendly form of energy.
- photovoltaic is being done to make them cheap, light weight and more efficient.
- Nanotechnology can contribute to the further reduction of combustion engine pollutants by nanoporous filters.
- Nanotechnology can help in developing new environmental safe and green technologies that can minimize the formation of undesirable byproducts or effluents



V. Nanotechnology in Space Exploration

- A new electric propulsion concept proposes to utilize electrostatically charged and accelerated nanoparticles as propellant.
- Millions of micron-sized nanoparticle thrusters would fit on one square centimeter, allowing the fabrication of highly scaleable thruster arrays.
- Radiation shielding is an area where nanotechnology could make a major contribution to human space flight.
- Improved communication performance, instruments and sensors breakthroughs, innovative components and materials, Intelligent space systems operation.

Conclusions

- Nanoscale materials engineering will have an increasingly important impact on a number of sectors.
- Nanomaterials possess extremely large grain boundaries relative to their grain size.
- Hence, they are very active in terms of their chemical, physical, and mechanical properties.
- Due to their enhanced chemical activity, nanomaterials can be used widely.