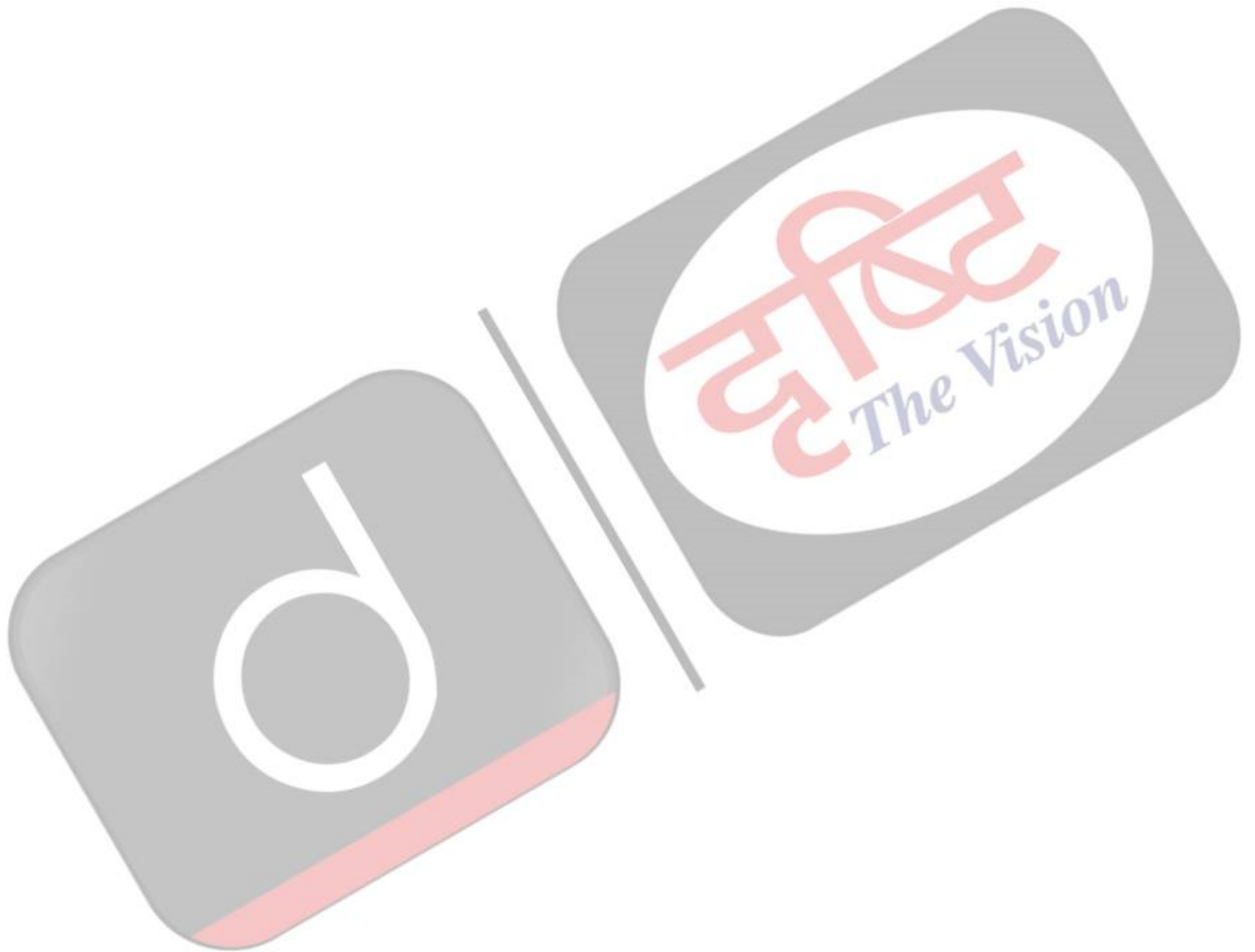




Nanotechnology

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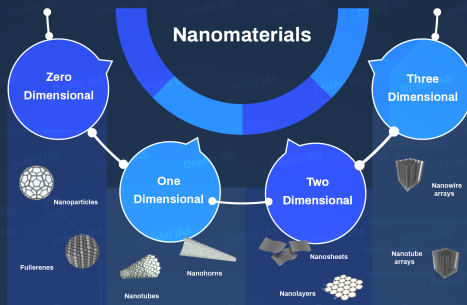
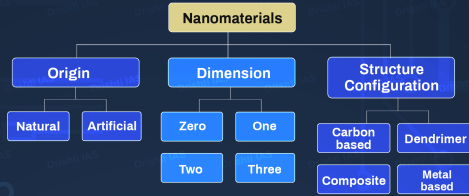
Nanotechnology and Nanomaterials

Nanotechnology is the branch of science and engineering focused on manipulating matter at the atomic and molecular scale (dimensions ≤ 100 nanometers).

Nanomaterials

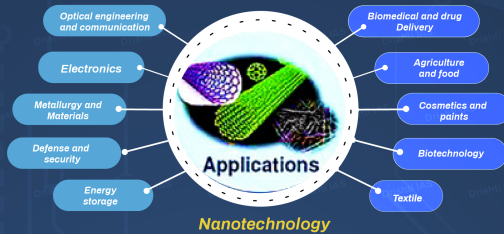
Materials with at least one dimension ≤ 100 nm

Classification:



Properties:

- **Mechanical Strength:** Higher durability and lightweight – ideal for aerospace and automotive
- **Quantum Confinement:** Alters electronic properties at nanoscale – enhances semiconductor performance and display technologies
- **Increased Surface Area:** Enhanced catalytic properties – ideal for chemical reactions and environmental cleanup
- **Magnetic Properties:** Exhibits superparamagnetism – useful in data storage



Nanotechnology in India – Evolution

Chintamani Nagesa Ramachandra Rao is regarded as the father of Indian nanotechnology.

- **9th Five-Year Plan (1998-2002):** Introduced nanomaterials into India's strategic science goals
- **10th FYP (2002-07):** Launched National Nanoscience and Nanotechnology Initiative (NSTI)
 - Nano Science and Technology Mission (NSTM) (2007) pushed nanotechnology into mission-mode R&D
- **12th FYP (2012-17):** Phase-II of NSTM
- Institute of Nano Science and Technology (INST): Estd. 2013

Challenges	Way Forward
<ul style="list-style-type: none"> • Safety & toxicity • Efficient mass-production • Inadequate regulatory frameworks • High production expenses • IPR related legal complexities 	<ul style="list-style-type: none"> • Prioritising R&D and fostering international collaboration • Rigorous testing of nanomaterials to assess their potential toxicity • Develop comprehensive regulatory frameworks + ethical guidelines



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