

## Nano Science Tools, Technologies, and Applications

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### DESCRIPTION

The utilization of matter on an atomic, molecular, and supramolecular scale for industrial purposes is termed as nanotechnology, or just nanotech. The earliest and most common definition of nanotechnology, also known as molecular nanotechnology, focused on the specific technological purpose of accurately manipulating atoms and molecules for the development of macroscale objects.

### Current research

**Nano materials:** The field of nano materials encompasses sub-fields that create or research materials with special attributes brought on their Nano scale dimensions. Many materials that may be beneficial in nanotechnology, including carbon nanotubes and other fullerenes, as well as other nanoparticles and nanorods, have been developed thanks to interface and colloid science. Nanoscale materials can also be utilized for bulk applications; most existing commercial applications of nanotechnology are of this type.

**Biomimetic approaches:** Bionics, also referred as bio mimicry, is the study and design of engineering systems and contemporary technology by borrowing biological principles and systems from nature. One of the systems examined is bio mineralization. The term "bio nanotechnology" refers to the utilization of biomolecules, such as viruses and lipid structures, for nanotechnology applications. One potential application at the bulk level is Nano cellulose.

**The dimensions of nano materials:** The categorization of nano materials contains 0D, 1D, 2D, and 3D nano materials. The physical, chemical, and biological characteristics of nano materials are significantly influenced by their dimensionality. Surface-to-volume ratio is appears to rise when dimensionality reduces. This shows that, in comparison to 3D nano materials, smaller dimensional nano materials have a higher surface area.

Two-dimensional (2D) nano materials are currently being studied in depth for use in biological, electrical, drug delivery, and biosensor applications.

### Tools and techniques

There are numerous contemporary developments. Nanotechnology was introduced *via* the Atomic Force Microscope (AFM) and the Scanning Tunneling Microscope (STM), two early iterations of scanning probes. Other variations of scanning probe microscopy exist. The resolution of most recent scanning probe microscopes is substantially higher since they are not constrained by sound or light wavelengths. Numerous nanolithography techniques, including optical lithography, X-ray lithography, dip pen nanolithography, electron beam lithography, and nano imprint lithography, have also been developed.

A top-down fabrication method called lithography shrinks a bulk material to a Nano scale design. Nano imprint lithography, deep ultraviolet lithography, electron beam lithography, focused ion beam machining, molecular vapour deposition, and molecular self-assembly methods are among another group of nano technological techniques. These methods also used to create nanotubes and nanowires, as well as semiconductors. In contrast to methods that were specifically created for the development of nanotechnology and which were the results of nanotechnology research, the ancestors of these methods precede the nanotech period and are progressions in the development of scientific accomplishments.

### Applications

The majority of applications are limited to "first generation" passive nanomaterial's, which include zinc oxide in paints and varnishes for outdoor furniture, titanium dioxide in sunscreen, cosmetics, surface coatings, and some food products, carbon allotropes used to make gecko tape, silver in clothing, home appliances, disinfectants, and food packaging, and cerium oxide as a fuel catalyst. Due to various uses, tennis balls can also last longer, golf balls can already fly straighter, and even bowling balls can have a stronger surface. Nanotechnology may make it possible for current medical applications to become more accessible and economical in locations like the general practitioner's office and at home.

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