



Principles and Methods of Nanofabrication

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Description

The term nanofabrication describes the process of creating nanoscale materials and gadgets. One millionth (10^{-9}) of a metre is a nanometer. The large-scale parallel processing of material with nanofabrication is beneficial. A large-scale economy can be produced utilising the same equipment, design, and minimal amounts of material, which is a cost-effective way.

Modern technology is used in nanofabrication, which is mostly used to produce high-tech silicon chips like microchips and microcontrollers. For scientists working in the aerospace, medical, and military sectors, interest in nanofabrication is expanding. When compared to large devices, nanofabrication focuses on the atoms in a material and how to reduce time, money, and space.

The development of nanoscale science and engineering, which is transforming and improving human production and lifestyle, is supported by nanofabrication technologies, which act as a link between fundamental principles and applications of nanotechnology. Nanoimprinting, electron beam lithography, focused ion beam cutting, and scanning probe lithography are a few alternatives to photo lithography that have made significant advancements in the semiconductor industry, IC production, and Micro/Nano Electro Mechanical System (MEMS/NEMS) devices. Yet, there are still many obstacles to overcome in order to produce high-quality goods with continued advancements in nanotechnology in terms of resolution, cost, speed, and other factors. It is crucial to investigate novel nanofabrication techniques because none of the currently available approaches can simultaneously address all the needs in nanoscience and nanotechnology.

Friction-induced nanofabrication offers prospects for maskless, flexible, low-damage, low-cost, and environmentally friendly processing on a variety of materials, including silicon, quartz, glass surfaces, and so forth. It is a newly invented Scanning Probe Microscope (SPM)-based lithography. It has been demonstrated that this method of fabrication offers a wide range of potential applications in the creation of microfluidic devices, micro/nano optical structures, and nanoimprint templates.

With the advent of nanofabrication, Integrated Circuits (ICs), which have played a significant role in electronic devices for many years, have undergone a revolution. Because to programmable nanomachines, the circuits are now created atom by atom, similar to how a structure is constructed brick by brick.

Integrated Circuit

A compact semiconductor-based electronic device called an Integrated Circuit (IC) is made up of manufactured transistors, resistors, and capacitors. Integrated circuits are the fundamental components of the majority of electronic apparatus and machinery.

The main goal of an integrated circuit is to fit as many transistors as possible onto a single semiconductor chip as of 2012, this number has reached the billions.

Integrated circuits have gone through various generations of improvements and developments according to their design assembly, including:

- Small Scale Integration (SSI) uses chips with tens to hundreds of transistors.
- Medium Scale Integration (MSI) Many chips with hundreds to thousands of transistors
- Large Scale Integration (LSI) Many chips with tens of thousands to hundreds of thousands of transistors
- Very Large Scale Integration (VLSI) which uses chips with up to one million transistors
- Ultra Large Scale Integration (ULSI) this is an example of a contemporary Integrated Circuit (IC) with millions and billions of transistors on each chip.

An IC can also be divided into digital, analogue, or hybrid categories. The computer processor, which is made up of billions of manufactured transistors, logic gates, and other digital circuitry, is the most typical example of a modern IC.

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