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Different Types Techniques in the Field of Nanolithography

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Opinion Article

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DESCRIPTION

A developing area of nanotechnology techniques called Nanolithography (NL) focuses on the engineering (patterning, such as etching, depositing, writing, and printing) of nanometre-scale patterns on diverse materials.

The current phrase refers to the design of buildings constructed at the nanoscale scale, or between 109 metres and 106 metres. The field essentially derives from lithography and exclusively deals with very tiny structures. The four groups of NL techniques are photo lithography, scanning lithography, soft lithography, and various ad hoc approaches.

Photo lithography

Optical lithography: One of the most important and widely used groups of techniques in the field of nanolithography is optical lithography (also known as photolithography). Optical lithography has a number of significant derivative techniques, all of which alter the solubility of specific molecules, causing them to dissolve in solution and leaving behind the desired structure.

Phase-Shift Masks (PSM) and Optical Proximity Correction (OPC), two technologies for enhancing resolution, are used in several optical lithography processes. Multiphoton lithography, X-ray lithography, Light Coupling Nanolithography (LCM), and Extreme Ultraviolet Lithography (EUVL) are a few of the covered techniques in this group.

Quantum Optical Lithography (QOL): A red laser diode with a wavelength of 650 nm is used in the diffraction-unlimited technique known as Quantum Optical Lithography (QOL), which can write with a resolution of 1 nm. At 3 nm resolution, complex patterns like letters and geometrical forms were produced on a resist substrate. The technique was used on nano pattern graphene with a resolution of 20 nm.

Scanning lithography

Electron-Beam Lithography (EBL): In order to create bespoke shapes EBL or electron-beam direct-write lithography (EBDW) scans an electron beam onto a surface covered with an electron-sensitive film or resist (such as PMMA or

HSQ). Sub-10 nm resolutions have been attained by altering the resist's solubility and then selectively removing particles by submersion in a liquid. Single-column e-beams can only be used for research and development, limited-volume manufacture of semiconductor devices, and photomask fabrication with this type of direct-write, maskless lithography due to its high resolution and low throughput. The purpose of multiple-electron beam methods is to boost semiconductor mass production throughput. EBL can be used to selectively nanopattern proteins on a solid substrate with the goal of enabling ultrasensitive sensing.

Scanning Probe Lithography (SPL): Another set of methods for patterning at the nanoscale scale down to individual atoms that use scanning probes include SPL, which involves either directly writing new material onto a substrate or etching away undesirable material. Dip-pen nanolithography, thermochemical nanolithography, thermal scanning probe lithography, and local oxidation nanolithography are a few of the significant methods in this area. Of these methods, dip-pen nanolithography is the most popular.

Proton beam writing: This method has been demonstrated to be capable of creating high-resolution patterning much below the 100 nm threshold by using a focussed beam of high energy (MeV) protons to pattern resist material at nanoscales.

Charged-particle lithography: This collection of methods encompasses ion- and electron-projection lithographies. Ion beam lithography transfers patterns to a surface by using a focused or broad beam of energetic lightweight ions (like He+). On non-planar surfaces, nano-scale features can be transferred using Ion Beam proximity lithography.