# Review on Lithography Techniques

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***ABSTRACT: This article examines important technology and applications in micro and nanolithography's from industrial micro devices to novel nanotechnology and scientific applications. The main technique in the production of integrated circuits and microchips was micro- and nanolithography's across the semiconductive sector. Such technology also drives nanotechnology advances to revolutionize. The methods of lithography include UV-lithography, lithography based on electron beam as well as soft lithograph and scan samples techniques. In addition, its applications are split into four important sectors, namely microelectronics as well as systems of microscale size, biomedical as well as biotechnology, optical, as well as energy as well as climate production.***

***KEYWORDS: Fabrication, Lithography, Microlithography, Nanoscale lithography, Scanning Probe.***

## INTRODUCTION

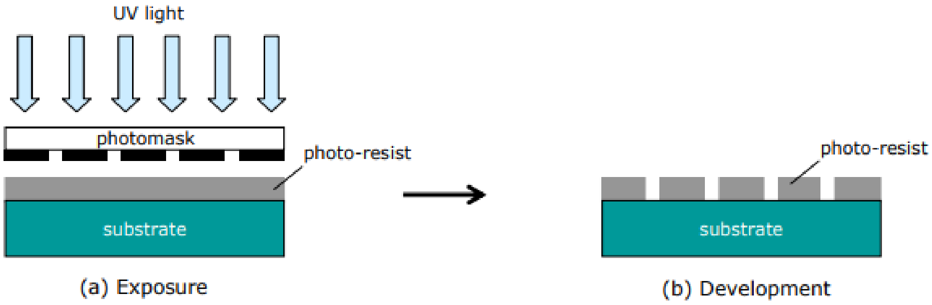
For decades, the production of ICs [1] and microchips has been contributing to micro and nanolithography technologies. This progress in the materials as well as chips sector move to the growth of computers and the Internet, a new data emerging paradigm. The technology for creating motifs of various sizes from few nanometers up to tens of millimeters, is micro and nanolithography [2]. The combination of lithography with additional production methods including coating as well as grafting may generate a high-quality imaging. This step may often be repeated to produce intricate micro/nano-scale patterns. Patterning approaches are separated in dual categories through means of masking: masking-based patterning technique as well as patterning by masking less. Masking based technique employs photomasks and molds to transport structures across a vast region concurrently, enabling high performance production of up to several decades of wafers per hour. Photolithography, soft lithography and lithographic nano-impression are masked lithograph processes. On the other hand, masks with fewer lithographs like electron beam lithographs and directed ion beam lithographs generate arbitrary patterns without using masks by means of a serial writing. Scanning sample lithography. Such approaches serially build patterns that allow the patterning of arbitrary structures with feature size of some ultra-high-resolution nano scale. However, this sluggish seriality, which makes it unsuitable for mass manufacturing, limits the output of this kind.

Micro- and nano lithographic technology is not only the leading emerging advancement in the semiconducting material as well as chip sectors, but acts a growing protagonist in producer micro-electromechanical (MEMS) devices and in prototyping in the burgeoning sciences and engineering sectors of the nanoscale. These technologies are meant to enhance the excellence of life greatly in numerous conducts from mobile devices to diagnosis gadgets. For example, the MEMS accelerometers of automotive and consumer electronics goods, the DMD [4] for screen and screening applications, and the MEMS Pressure Sensors [5] utilised in the sense of strain in vehicle tyres and blood vessels are commercial MEMS goods. Furthermore, by introducing other roads, nanoscience and engineering have substantially increased traditional technologies, Nanoelectronics for faster and more dense computing, diagnosis and treatment of a wide range of diseases, e.g., tumours, heart disease or Alzheimer's disease, greater sensitive, greater precision detection as well as manipulation systems as well as lesser dilution biosensors as well as one-molar molecular detections, are just a few.

## MICRO AND NANOLITHOGRAPHY TECHNIQUES

### *1. Photolithography:*

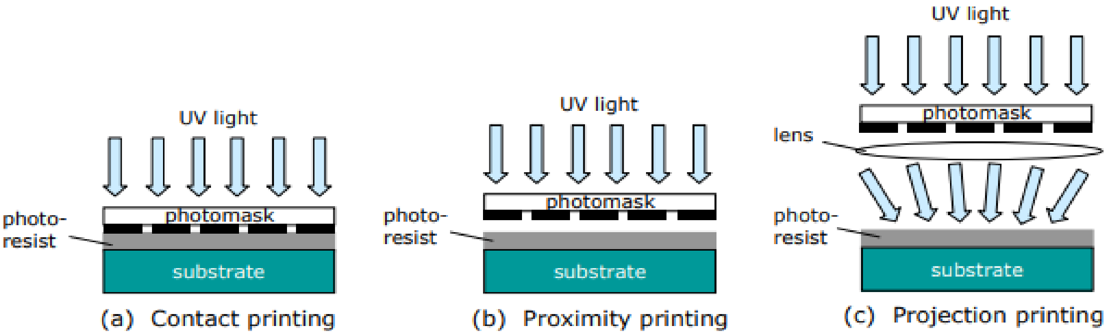
The main workshop on the semiconductor and IC market was photolithography [6]. It has been used as an industrial model generator to produce ICs, microchips and MEMS systems. This approach involves exposure to ultraviolet (UV) light from a light sensitive polymer to generate a desired design. At first the photomask, consisting of impervious profiles on a better substratum, is used to illuminate UV light in wavelengths of 193-436 nm, in order to allow exposure to a photo resistance coated on a substratum. The photo-resistant polymer chains break apart in the exposed region and become more dissolvable solution known as etchant. The open light-resistor is then eliminating in etchant to make up required photograph structure. The main photolithographic measurements scheme is shown in Figure 1. Fig. 1. Such a patterned photo-resistant may be employed in later etching or deposition procedures as a protective layer to produce a topography on the substrate.



(a) Exposure (b) Development

**Figure 1: Schematic Illustration of the Various steps involve in photolithography**

Top printing, near letterpress, as well as printing based on projection as indicated in the Figure 2 are three photolithographing procedures. The photo masks are in contact with or nearby photo-resistant while printing touches and vicinity. Printing contact and closeness usually makes patterns as tiny as a few micrometers. They are therefore generally utilized in manufacturing of intermediate precision structures, notably in labs as well as SMEs. It should be borne in mind that in most research efforts, photolithographs frequently include touch or nearness printing. In contrast, an optical lens device is used to print a deep-UV photo-resisting picture from an excimer laser (193 or 248 nm in wavelength), which allows for a decrease of 2-10 times in pattern size, using a photo-projectile printer ('stapper' At a high throughput (60-80 wafer/h), it can make greater precision structures as low as a few decades. However, a complicated optical lens system, precise temperature and position control systems are required which will result in highly expensive installation. It is utilised for the manufacture of sophisticated ICs and CPU chips. Due to improved projection print lithographic resolution, immersion photography, resolution enhancement technologies and ultra-UV lithography in recent years.



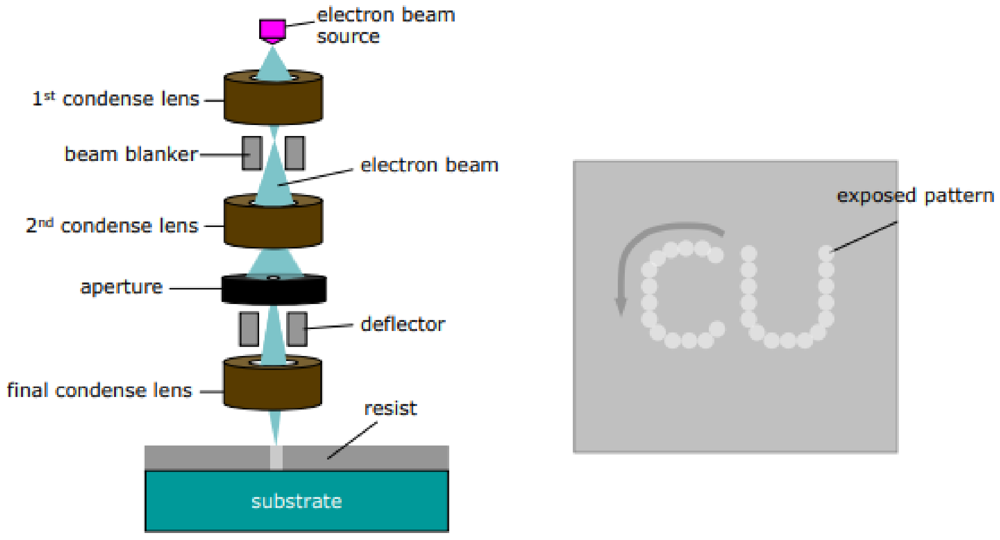
(a) Contact printing (b) Proximity printing (c) Projection printing

**Figure 2: Schematic Representation of the Various Mask Alignment Strategies Associated with UV lithography**

*2. Patterning technique based on electron beam as well as focused ion beam:*

These two patterning techniques were the principal approaches for making nano-scale designs. In order to produce a photo, an accelerated beam of electrons [7] employs an electron-controlled resistor to produce an image. This beam spot with a diameter of as few nanometers is then scanned over the resistant surface in a point-by-point manner to form sequence patterns (Figure 3). Similarly, the lithography of a focalized beam ion employs an accelerated beam (usually gallium ion) to punch a metallic coating directly on the shield rather than the electron beam. It is likely because of the greater mass of ions in contrast to electrons. In order to deposit tungsten, gold and carbon via deposition from the ion beam, the oriented beam tools can be employed. The precursor has a non-volatile part (tungsten) of the gas on the surface, is plagued by the focused ion beam, which causes it to decompose.

The precision of the electron's rays as well as the beam based on focused ion beam methods in the range of 5 to 20 nm are specificized because of small wavelength of the beams of several nanometres. Your applications in research and mask production are nonetheless restricted by a lack of performance. Both of these technologies are utilised in nanoscale structures and electronics, as well, routinely. In order to increase device performance, multi-axis electron beam lithography was recommended. The applicability in industrial processes of this approach is currently restricted because of the challenge of developing realistic sources of electron beams. Earlier, beam-based patterning technique was costly and hence limited utilization. Imaging tool was recently integrated with systems to build nanoscale patterns for electron beam systems, allowing scanning of electron beam sites in the appropriate locations. This technology has thus been widely applied and has contributed greatly to nanoscience development.



(a) Side view (b) Top view

**Figure 3: Schematic Illustration of the E-beam patterning techniques system overview**

*3. Soft lithography as well as lithography based on nanoimprint:*

Soft lithograph [8] was developed by the idea of a relatively soft polymer stamp to impress on a pattern transfer substratum a molecular (ink) solution. This process necessitates cheap susbtances as well as inappropriate tools. Initially presented in 1989 by Bain as well as Whitesides. This procedure may be detached in dual primary stages: manufacturing and the usage of a structured material imprint in geometry dictated by the relief structure of the object to translate molecules. A soft lithograph diagram is shown in Figure 4. The benefit of this approach is the use of a soft stamp for passing patterns which allows for the better bonding among the stamper as well as the substratum, which results in a versatile or folded medium moving capacity.

Nanoscale patterning is a hard mold that is graded on a polymer sheet compared to soft lithography. In comparison to soft lithography. This patterning technique grown as possibility for the better production approaches, since the photo-lithographic problem can be solved with significant promise and a relatively reasonable cost for high output and high-resolution processes. S.Y. Chou first invented a "hot embossing" nano-imprint lithograph, which enables to specify lateral-sized characteristics up to 10 nm below. The process warms the thermoplastic polymer over its transition temperature allows material mobility and a mould structure to be filled. The temperature is then decreased and the patterns repeated are hardened to remove the mould. Quartz and silicon were the most often utilized mould materials, which are strong substances kinds. Profiles normally are structured by classic techniques of patterning, including patterning based on the UV as well as e-beam. A robust substratum provides multiple benefits for manufacturing. The inflexibility preserves a nanosized with minimum location specific distortion. In addition, a solid mould is environmentally unchanging at greater temperatures. While patterning technique based on nanoimprint has progressed considerably over a very short period, there remain few challenges to be resolved. One of them is a mold's lifespan. Heating/cooling cycles and strong pressures exerted in precipitation produce strain and mould damage. This voltage also presents a multi-layer production alignment difficulty. The viscosity of the embossed substance is equally important. The reduction of patterns and increasing density of details appear to be a limiting factor

## *4. Scanning probe lithography:*

The lithographic scanning probe[9] employs an AFM sharp probe[10] for the melting, scraping, oxidising, or transfer of chemicals to a substratum surface to pattern the nanoscale features. The techniques for depositing small size particles on the base termed nanoscale patterning technique called as dip-pen based technique. are most prevalent. These techniques are most often employed. The dip-pen nanolithograph may be carried out in an ambient state without the involvement of any wide field associated with the electromagnetic energy. This approach employed for the primary time to transport particles to a newly grown silver base. The Atomic level Microscope cantilever is covered through a solvent immersion or a thin coating of a chemical of interest on the cantilever. Chemical compounds are coated on a substratum surface during writing. Figure 5 shows the diagram of patterns based on the dip-pen. One disadvantage of this technology is that its produced field is challenging to enhance. It may be used to build enormous arbitrary parallel patterns without mask. The structure of troughs in a 35 nm polymer film was demonstrated. Strong substances including silicone as well as PDMS-elastomers are used for the traditional sample tips, whereas nanomaterials such as nanoparticles, liquid solutions and organic compounds may be published. Recently, features from production such as processing rate, lifetime and usefulness of the dip-pen nanolithography have been reported.

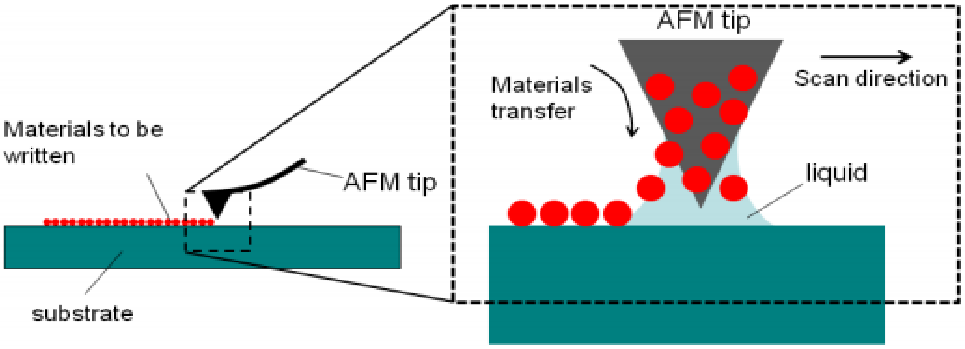


**Figure 5: Schematic view of dip-pen nanolithography**

## CONCLUSION

The study outlines key micro and nanolithographic methods, counting patterning based on UV, e-beam as well as central beam of ions, soft-lithograph, technique of nanoimprint and patterning of dippenes. The development of the semiconductive and IC sectors and consumer MEMS products have also led to lithography technologies. In the manufacturing processes of IC, microchip and MEMS, including microaccelerometers, DMD, MEMS based pressure measurement, microscale pumps, microwave valves, visual devices, heads of inkjet, micro-mirrors as well as actuators based on microscale, photolithography has for the last decades been the primordial technique. The comprehension of alternative techniques in lithographic fields for a variety of applications has been comprehensively expanded: electron beam and centralized ion beam lithography for R&D nanoscale design, production of photo-masks and IC's, Soft patterning technique for greater spectrum of LOC utilizations, Nano-Electronic and Nano-Channel lithography, bio-Sensor Nanometric lithography; B Nanoimprint lithography has continuously evolved, since it is capable of overcoming the problems in classic patterning techniques, thereby ensuring a greater-performance, greater-precision procedure at fairly cheap cost.

The future of nanoscience and research is formed by the nanolithography technology. This new area offers alternative approaches to resolve existing technical hurdles in several sectors, including nanoelectronics, nanomedicine, nanoelectromechanical systems and nano-biosensors. Such significant nanoscience and technology breakthroughs lead to technical improvements in a wide spectrum from the next generation's mobiles to healthcare systems and from cosmetics to fabrics, from farming to bigger-tech companies.

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