Multiple Lithography Method for Directed Materials Assembly
Technology #13540

Applications

- Microlithography
- Resists and ancillary material fabrication

Problem Addressed

Nanofabrication consists of the construction of electronically useful devices on the nanometer length scale. As the nanofabrication industry reaches the limits of Moore's law, innovation must be taken in a new direction and instead of simply reducing the size of electronic circuits, work must be done to streamline the construction of nanoscale devices. To this end photolithographic methods have been developed to better control the circuit fabrication process.

Technology

In photolithography, light is applied to a substrate to change its surface chemistry. The process can be used in nanofabrication to pattern surfaces for the self assembly of diblock copolymers which consist of two chemically different polymer chains connected at one end by a covalent bond that can spontaneously form ordered structures at the molecular scale. The proposed technology iterates the standard lithographic process of diblock copolymer assembly in order to define more specific patterns for self assembly and hence obtain more control over the created patterns.

The process employs multiple resistless lithographic steps that directly change the surface energy of the resist without requiring subsequent surface modification, deposition, or plasma etch steps. In this approach the initial surface modification followed by imaging gives one a surface differentiated from the initial surface by a number of material surface properties.

Lithographic Approach

A second surface modification step is employed to convert the exposed region to a third surface different from the first and the second by type of surface energies. The result of double surface modification and imaging is that three different surfaces become lithographically defined on the original material surface and as such the final surface is more prone to directed material assembly.

Advantages

- Lithography directed assembly has a resolution defined by the thermodynamic properties of the diblock copolymer instead of the chemistry of the resist, thus allowing manipulation to yield sub-10 nm patterning.
- Approach does not employ traditional resist based lithography to define the pattern, thereby reducing the processing steps and manufacturing costs
- Approach is possibly the only viable method to produce sub-22 nm based integrated circuits
without the use of directed self assembly

Categories For This Invention:

Electronics & Circuits
Semiconductors & Integrated Circuits
Lithography
Block Copolymers
Lincoln Laboratory

Intellectual Property:

Directed material assembly
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Inventors:

T. H. Fedynyshyn
Richard Kingsborough

External Links:

Lincoln Laboratory
http://www.ll.mit.edu/

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