



Materials and Methods for Creating Nanoscale Patterned Features with Atomically Smooth Surfaces

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WARF: P05233US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing methods for producing "Manhattan-style" patterned features called "polymer brushes."

Overview

Production of faster, more powerful microelectronics requires that device features continue to shrink in size. Current lithographic processes based on chemically amplified resists routinely pattern features with dimensions less than 100 nm. But as feature sizes fall below 50 nm, problems such as line edge roughness, critical dimension control, and collapse of structures due to capillary forces begin to emerge with these traditional techniques.

The Invention

The methods developed by UW-Madison researchers can now produce "Manhattan-style" patterned features less than 50 nm in size, with tall vertical sidewalls, high aspect ratios and atomically smooth surfaces. These patterned features are called "polymer brushes." To make them, polymers such as styrenes, acrylates, and silanes are grown and covalently bonded to a substrate at an initiation, or grafting, site. The principal innovation is that surface tension between the polymer and air, or between the polymer and a solvent, is exploited to produce atomically smooth surfaces on features as small as 25 nm. The researchers also showed that by varying the polymers' grafting density and molecular weight, they could control polymer brush height and aspect ratio.

Applications

- Masks for pattern transfer techniques, such as reactive ion etching

Key Benefits

- Provides "Manhattan-style" patterned features as small as 25 nm in dimension, with tall vertical sidewalls, high aspect ratios and atomically smooth surfaces
- Offers ready control of feature dimensions, such as height and aspect ratio
- Once patterned, brushes can be shaped and reshaped with thermal or solvent treatments to achieve desired profiles for resist masks
- Maintains discrete (non-collapsed) features
- Polymer brush chemistry is independent of the patterning process, allowing brushes to be optimized for specific applications
- Capable of forming any pattern found in the microelectronics industry, including irregular features (e.g., angles) and arrays of dots

Tech Fields

- [Materials & Chemicals : Polymers](#)
- [Semiconductors & Integrated Circuits : Lithography](#)

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