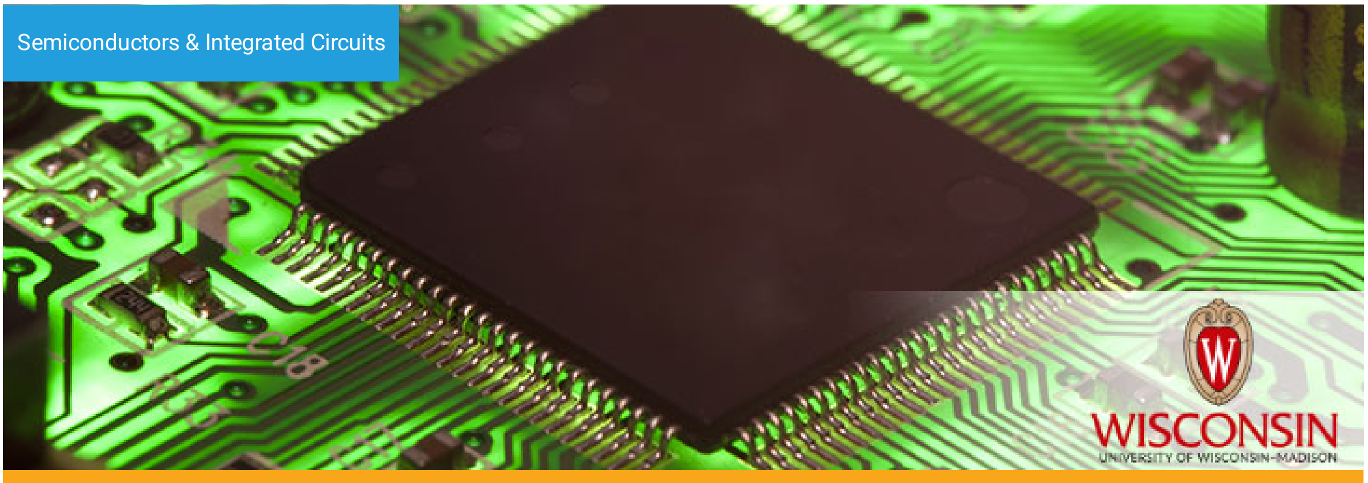

Improved Block Copolymer Engineering for Directed Self-Assembly of Thin Films

View U.S. Patent No. 9,580,534 in PDF format.

WARF: P110274US02

Inventors: Paul Nealey, Frank Bates, Sangwon Kim

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing methods of formulating block copolymers from novel materials that support structure dimensions smaller than 10 nanometers.

Overview

Block copolymers (BCPs) are a class of polymers synthesized from two or more bonded units. Forming BCPs in bulk, and turning the material into thin film, can produce nanoscale structures useful to many technologies from solar cells to semiconductors.

Fabricating the blocks into well-defined chemical patterns is critical. A patterning technique called directed self-assembly (DSA) combines the blocks' self-assembling ability with the lithographic tools to guide that assembly into desired structures. The method limits pattern variation and mismatches, and is superior to other patterning techniques.

In some implementations, DSA involves the thermal or solvent annealing of BCP material upon a patterning substrate. Previous efforts have focused on block copolymers made of poly(styrene-b-methyl methacrylate) (PS-PMMA). However, this material's low interaction restricts how small its dimensions can form.

The Invention

UW–Madison researchers have developed novel BCP material that can be used in directed self-assembly and allows structures smaller than 10 nanometers. Methods also have been developed to modify or synthesize material to have stronger interactive parameters without increasing the energy differences working between constituent blocks.

The thin-film BCP can be a poly(styrene-b-isoprene) (PS-PI) chemically modified to increase the first block's interaction property. The material is deposited on a patterning substrate with microphase-separated domains where it assembles accordingly.

Applications

- Nanolithography for semiconductor devices
- Fabrication of cell-based assays
- Nanoprinting
- Photovoltaic cells
- Next-generation flats screen displays

Key Benefits

- Improved resolution and functionality
- Smaller dimensions
- No preferential wetting during annealing

- Greater interactive parameter than PS-PMMA without increasing interblock energy differences

Stage of Development

The researchers have successfully demonstrated directed assembly of PS-PI by thermal annealing.

Additional Information

Related Technologies

- WARF reference number P110192US02 describes an improved method for direct assembly of microelectronic structures using solvent annealing of block copolymers.

Tech Fields

- Semiconductors & Integrated Circuits : Lithography

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842