Block Copolymer Lithography
- Fine nanopatterning by rapid directed polymer self-assembly -

**Motivation**
Top-down lithography—of which optical lithography is a prominent example—is reaching its critical limit, thereby raising difficulties in achieving sub-20-nm lithography. This study will focus on the development of an ultimate nanofabrication technique at the single-digit nanoscale by combining top-down and bottom-up approaches.

**Originality**
We have demonstrated that rapid graphoepitaxy of bottom-up self-assembled nanomaterials can be achieved by combining lithographically created alignment guides with high-temperature short-time processing. We have also achieved pattern transfer from rapidly aligned domains to the substrate. As a result, dense lines of amorphous silicon with a pitch of 42 nm can be formed.

**Impact**
This study would enable the fabrication of nanostructures at the single-digit nanometer scale—an objective that cannot be achieved simply by top-down technologies. Our results could provide the impetus for large-scale production of novel nanodevices, especially quantum effect devices, as well as conventional nanodevices that are subject to a scaling law.

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**Block Copolymer Lithography**
- Single layer of microphase separated domains is used as lithography template

**Self-assembled nanomaterials**
- A-B diblock copolymer
  - Random structure
  - Microphase separated structure

**Microphase separated structures of diblock copolymers**
- A Sphere
- A Cylinder
- A,B Lamella
- B Cylinder
- B Sphere

**Microphase separation of diblock copolymers**
- Self-assembly
- Annealing
- 10–50 nm

**Rapid Graphoepitaxy & Pattern Transfer**
- Rapid graphoepitaxy can be achieved by combining lithographically created guides and high-temperature short-time processing.

**Rapidly aligned domains**

**Si patterns after etching**

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