Chujun Wang

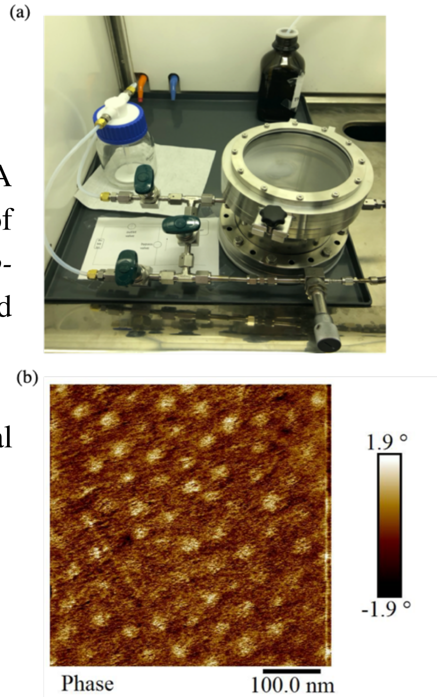
Design of solvent vapor annealing tool and study of kinetics of self-assembly of block copolymers for nano-lithography

Block copolymer (BCP) lithography is a very promising candidate for nanoscale fabrications and is economically viable. In this project, a well-controlled dynamic solvent vapor annealing (SVA) chamber is designed and built, and the best annealing conditions using this chamber are investigated. Different parameters in SVA process are studied, which helps us to get some understanding of the kinetics of the self-organization process.

Since the invention of the integrated circuit (IC), which packs transistors and other functional electronic components in one device, microelectronic industry has been developing rapidly and becomes the cornerstone of the modern information society. Lithography has been one of the core technologies to sustain the evolution of Moore's law and promote the design of advanced ICs and development of the new types of devices. Self-assembled block copolymers (BCP) thin films provide an inexpensive and straightforward approach to nano-size patterning and can be used in lithography and with other nano fabrication methods. Depending on type of BCP, structures as small as <10 nm with a high density can be produced, that is not possible using other lithographic techniques.

In the project, a dynamic solvent vapor annealing (SVA) chamber, which provides a controllable dynamic gas flow environment for the annealing of BCPs, is successfully designed and built. This chamber that can maintain constant humidity, temperature, and the solvent vapor evaporating rate during the annealing, was successfully tested. The SVA chamber combined with other parts, such as solvent bubbler and gas line form a dynamic SVA system, is shown in figure (a).

The project also included the investigation of optimum SVA conditions to obtain the hexagonally-oriented vertical cylinders of block copolymer Poly(Styrene)-block-Poly(4-Vinylpyridine) (PS-*b*-P4VP). Two main parameters were studied: annealing time and polymer film thickness. The best organization for the 50-57 nm thick polymer is obtained after 1 h annealing, which results in PS-*b*-P4VP equilibrium state producing hexagonally-oriented cylindrical structures with a pitch of 58 nm. The results are shown in figure (b).



Handledare: **Ivan Maximov**
Examensarbete 30 hp i Master of Science 2020
Fysiskainstitutionen, Lunds universitet