

Personnel

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Concept and Key Idea

Recently, researchers have successfully created nanodomains with block copolymer (BC) thin films and turned them into ultrahigh-density nanoporous templates. These nanoporous templates can potentially be applicable to a wide variety of nanoengineering applications, such as: nanoporous media and membranes, nanolithography and photonic bandgap materials. One of the biggest unsolved challenges is scaling up of the uniform nanostructure into long-range order templates, in order to be make real engineering applications feasible.

This project will try to address this challenge by proposing such a mechanism for the long-range ordering to be achievable. The proposed method will go as follows: first, short-range order templates are created in the form of pellets on silicon substrate, then the uniform di-block copolymer pellets will be removed from the substrate, and finally the pellets will be reassembled on a template using self assembly techniques. The schematic of this mechanism is illustrated by the following figure.

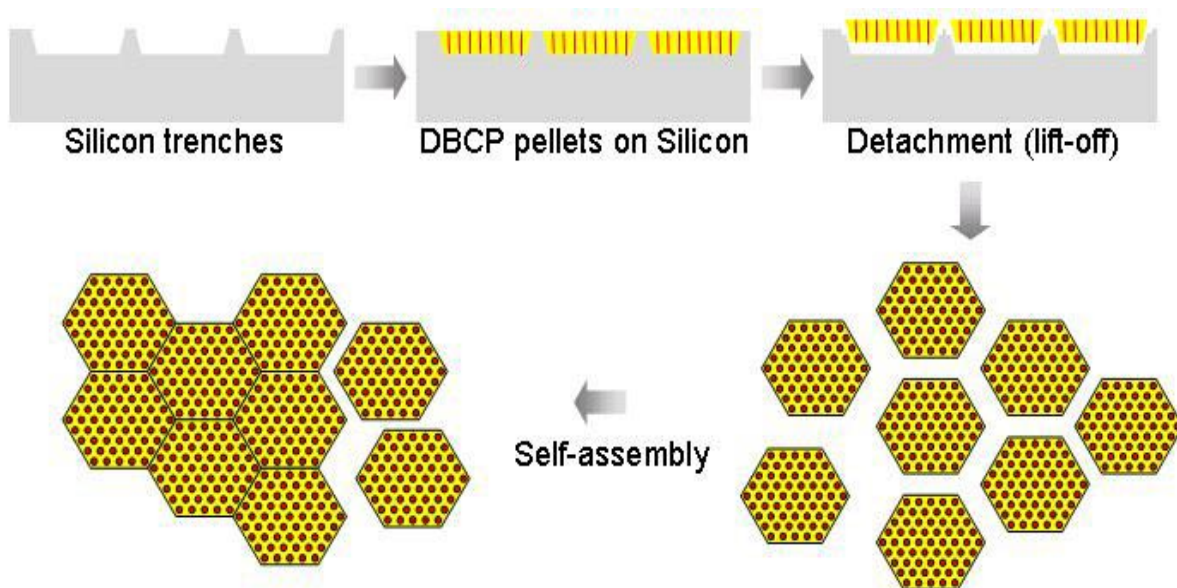


Fig. 3 Concept of building 2-D long-range ordered nanotemplates by nanopelleting

It is now well-known that ones can create various nanodomain shapes in block copolymer thin

film. For our purposes, we will use cylindrical nanodomain morphology. To achieve this morphology, we will use P(S-b-MMA) di-block copolymer thin film with PMMA volume fraction of approximately 30%. We will use random copolymer of styrene and methyl methacrylate for neutralizing the substrate surface in order to ensure the perpendicular alignment of the cylindrical nanodomains. Alternatively we can also use electric field to get this alignment.

Our research will investigate how feasible this nanopelleting method is and will certainly explore other possibilities to create long-range order templates. The short-term goal of our research is first to develop a procedure to successfully create uniform di-block copolymer pellets and the technique to reassemble them onto a macroscopic template. For a starting goal, We would like to achieve template scalability in the order of 1cm^2 . Once this can be achieved, we can further scale up the template size. We can then apply this method toward a certain technological application and perform further study to make this method more robust in term of manufacturing point of view. At the end, we would like to see this proposed method to be readily applied to manufacture a variety of real engineering applications.