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Microphase Seperation Depending on Different Parameters for Nanopatterned Devices

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We report a comparative study on microphase separation of a serial of block copolymers (BCPs) depending on some parameters such as solvent, annealing time. Toluene-Chlorobenzene mixtures show the best phase separation in comparison with other pristine or mixture of solvents. The results were optimized for large area studies.

Keywords: Block Copolymers, Microphase separation, Nanopatterned devices

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1. INTRODUCTION

There has been much recent effort toward developing new concepts for preparing regular structures with length scales approaching the molecular level, and the self-assembly of polymeric macromolecules is emerging as a powerful tool for the fabrication of nanoporous media, membranes, lithographic templates, and scaffolds for the assemblies of electronic, magnetic, and optical materials [1-2]. Therefore the fabrication of large-area periodic nanoscale structures with self-organizing systems is very interesting because of its simplicity, high degree of controllability, and low cost. Since self-assembled structure is less than 100 nm long, these materials are interesting for magnetic, electronic, and optoelectronic applications. Block copolymers, which, in thin films, microphase-separate into densely packed, periodic, cylindrical or spherical structures, can be used for pattering or templating various materials. Many high-density nanostructures, such as posts or holes in semiconductor and magnetic materials, have been achieved through etching, electroplating, or chemical reactions with block copolymer lithographic templates [3].

In this study, since the reports on a comparative study of different parameters on microphase separation is rarely available, we investigated the influence of solvent and temperature on micr0phase separation of a serial of BCPs.

2. EXPEIMENTAL

2.1 Chemicals

A number of block copolymer and random copolymer samples with different molecular weights (M_w) and narrow molecular weight distribution (M_w/M_n) were used in this experiment. Block copolymers were purchased from Polymer Source Inc. And random copolymers were synthesized with atom transfer radical polymerisation method.

2.2 Sample Preparation

Silicon wafer substrates were cleaned by immersion in a piranha solution (7:3 (v/v) of %98 H2SO4:%30 H2O2 at 90 °C for 60 minutes and then were immediately rinsed with deionised water two times. The silicon pieces were blown dry with nitrogen. Thena the solution of BCPs in diffeent solvents or solvet mixtures were spin casted at 1200 rpm on cleaned silicon surfaces.

3. RESULTS AND DISCUSSIONS

As mentioned in section 1, we prepared some BCP films on Silicn surfaces to determine the best route for facile microphase seperation. Fig. 1 shows AFM phase imagse of BCP films. All films were annealed at 170 C for solvet the srudy of solvent comparison. It is clear from figure, the most obvious and regular microphase separations were obtained with ratio of 1/3 by volume of the toluene / chlorobenzene solvent mixture. Pristine toluene also show extremely good phase seperation but worse then chlorobenzene mixtures. But we have to notice that the distance between the blocks was smaller in comparision with toluene / chlorobenzene mixture (Figure 2). No phase seperation is observed with THF. It is most probably the fast evaporation of THF during thermal annealing.

Figure 2 also shows high magnification of BCP films casted from toluene and toluene-chlorobenzene mixtures.

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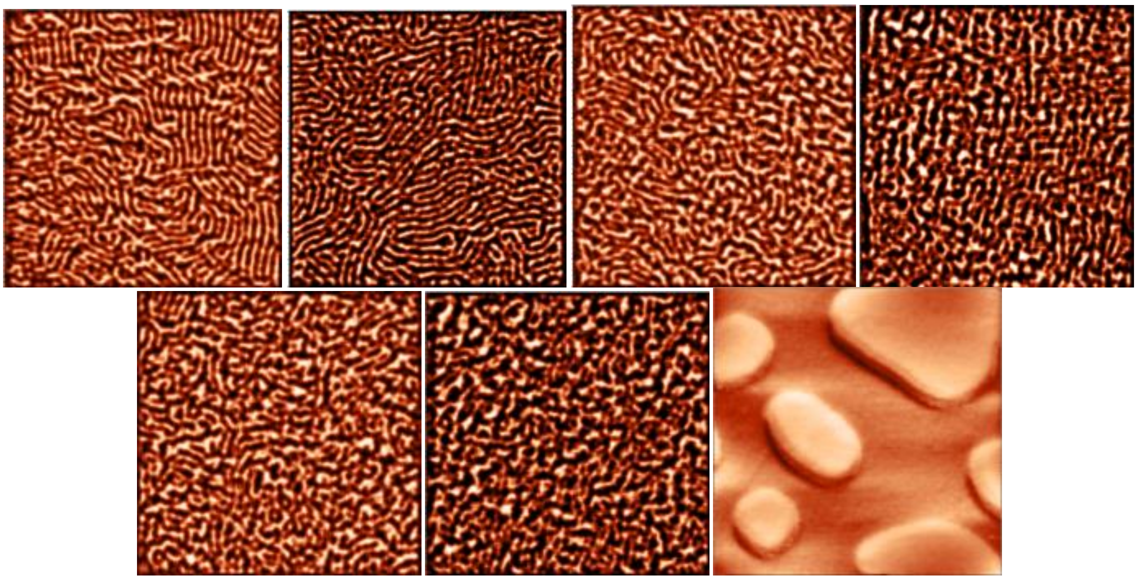

Fig. 1 – a-g. AFM images of phase separation of different solvent mixtures.

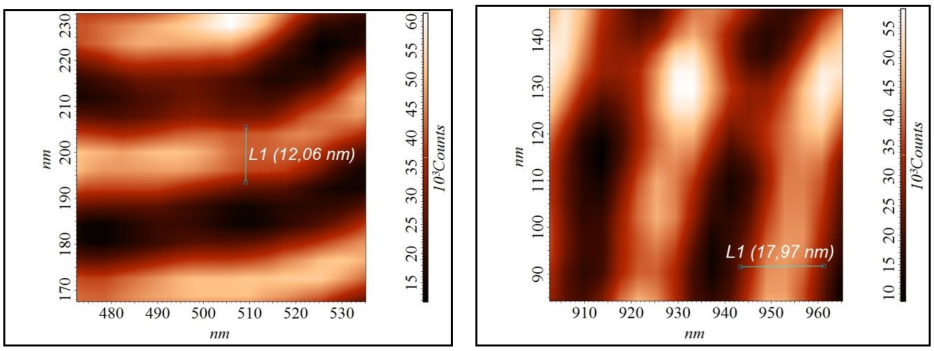

Fig. 2 – a-b. AFM images of BCP films casted from toluene and toluene-chlorobenzene mixtures

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REFERENCES

1. Park, M., Harrison, C., Chaikin, P., M., Register, R., A., Adamson, D., H., Block, *Copolymer Lithography: Periodic Arrays of ~10^{11} Holes in 1 Square Centimeter*, *Science*, **276**, 1401 (1997).
2. Ikkala, O., Brinkle, G., *Functional Materials Based on Self Assembly of Polymeric Supramolecules, Science,* **295**, 2407 (2002).
3. Lee, K., Park, S., Mirkin, C., A., Smith, J., C., Mrksich, M., *Protein Nanoarrays Generated By Dip-Pen Nanolithography*, *Science*, **295**, 1702 (2002).