

Defectivity and uniformity evaluation of block copolymer directed self-assembly for contact hole shrink 300mm-process

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Block copolymers (BCP) materials have been identified as potential candidates by ITRS¹ to further reduce current accessible lithographic dimensions. Indeed, the ability of such materials to self-assemble into various morphologies, their easiness and low-cost of processing, and the small dimensions of the self-assembled features render them very attractive for lithographic applications².

The main goal of this paper is to investigate the defectivity and the uniformity related with a contact hole shrink 300mm-process. Using the 300mm pilot line available in LETI³ and Arkema's materials, our approach is based on the graphoepitaxy of PS-*b*-PMMA block copolymers. The process is checked after each steps depicted in Figure 1 : a) the lithography (193nm) of guiding pattern into an upper layer (#2) , b) the directed self-assembly (DSA) of BCP (PS domain in blue and PMMA domain in red) and c) the transfer of PS pattern into a under layer (#1) by plasma etching.

The first topic investigated is the defectivity during the DSA of BCP. Some defects examples are showed in Figure 2. Defectivity statistics have been evaluated and confronted to the transfer rate of PS pattern. The effect of parameters such as the critical dimension (CD) and the pitch of the guiding pattern and the temperature of BCP process are studied. The second topic of interest is the uniformity in our process window on a 300mm-substrate. CD uniformity of the guiding and the PS transferred patterns are finely followed during the process and confronted. Furthermore the overlay between these two patterns is evaluated.

The research work leading to these results has been performed in the frame of the collaborative program IDEAL with the support of all these partners: CNRS laboratories (LCPO and LTM), SOKUDO, TEL, ARKEMA and LETI.

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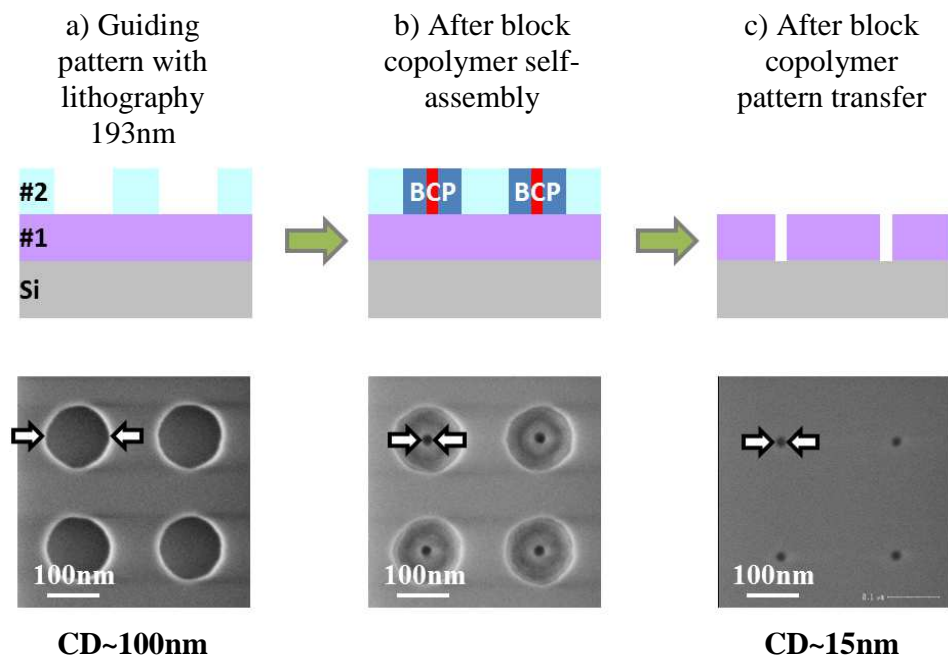
<http://www.itrs.net/Links/2011ITRS/2011Chapters/2011ERM.pdf>

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*Figure 1: Integration for contact hole shrink using DSA of PS-*b*-PMMA: a) Lithography of guiding pattern into an upper layer (#2), b) Directed self-assembly of BCP (PS domain in blue and PMMA domain in red) and c) Transfer of PS pattern into a under layer (#1) by plasma etching.*

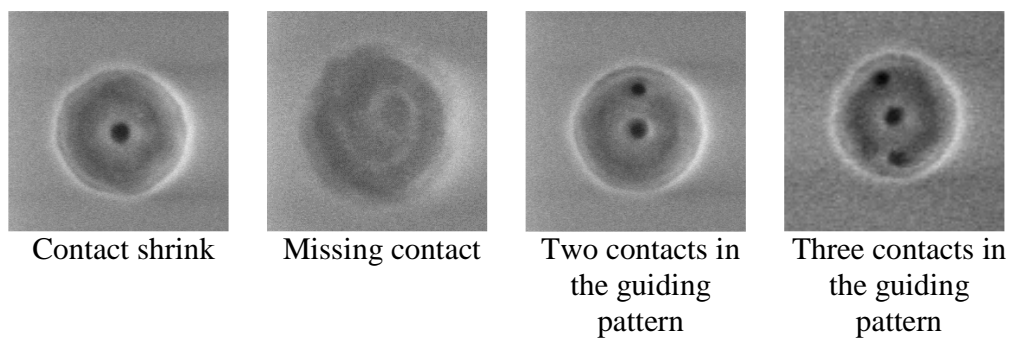


Figure 2: Examples of defects for contact hole shrink process