# A Cost-effective Nanoimprint Lithography Module

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Nanoimprint lithography (NIL)[1] is a low cost nanopatterning technique that challenges traditional photolithography in high resolution patterning. We have employed NIL to fabricate crossbar structures with half-pitch down to 17 nm.[2] While its resolution has exceeded that of photolithography, it still trails photolithography in the area of overlay. The traditional approach to preserving overlay is to improve the mechanical stability of the system; this inevitably adds cost and can potentially take away the low cost advantage of nanoimprint lithography. We have developed a novel approach to performing imprinting that preserves the alignment during template-wafer approach with no sophisticated machinary. So that it is possible for a very compact machine design. The key is to minimize both the moving parts and distance and shorten the mechanical path between template and wafer. The details will be presented.

While our approach is fully extensible to multi-die step-and-repeat printing for volume production, the focus of this paper is the first generation of this tool, which is a low cost module (<$50K) that can be incorporated into a mask aligner. (Figure 1) It takes advantage of the inherent ability of a mask aligner to achieve better than 0.5 micron of overlay, as demonstrated in Figure 2. The overlay is only limited by the resolution of the optical microscope. This nanoimprint module is oriented for R&D. It uses a UV-curable NIL process with double layer spin-coated resists.[3] The mold is based on a standard 5 inch mask blank platform and the field size is 1 inch x 1 inch. Gas pressure is used to make the imprint pressure uniform. With the module is loaded, the contact mask aligner is transformed into a nanoimprinter capable of doing the whole nanoimprint process including alignment, nanoimprint and mold/sample separation.

Details of the nanoimprinting approach, machine design, nanoimprinted results, and the integration of the our nanoimprint machine and alignment technologies, such as nDSE[4] and Morie patterns, will be presented.

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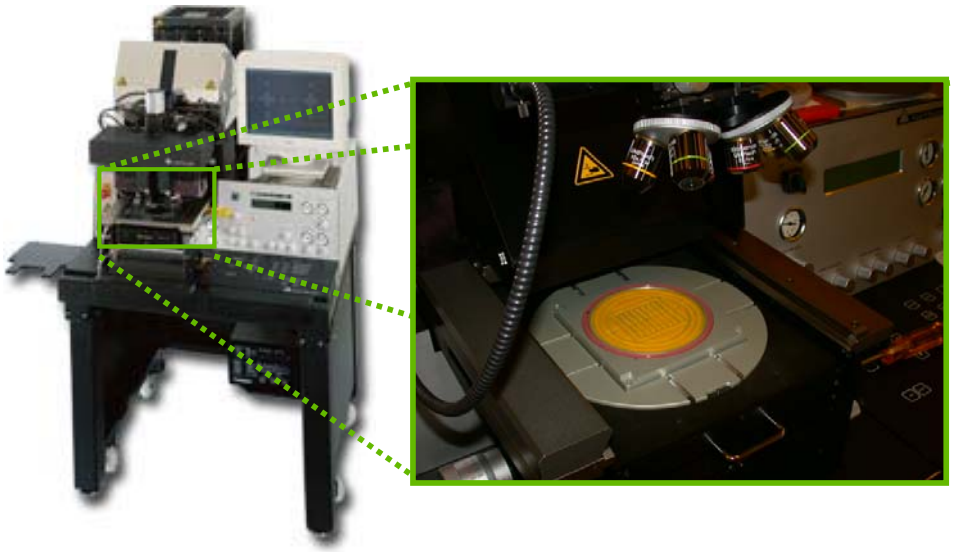

Figure 1. With the nanoimprint module loaded, a contact mask aligner is transformed into a nanoimprint machine.

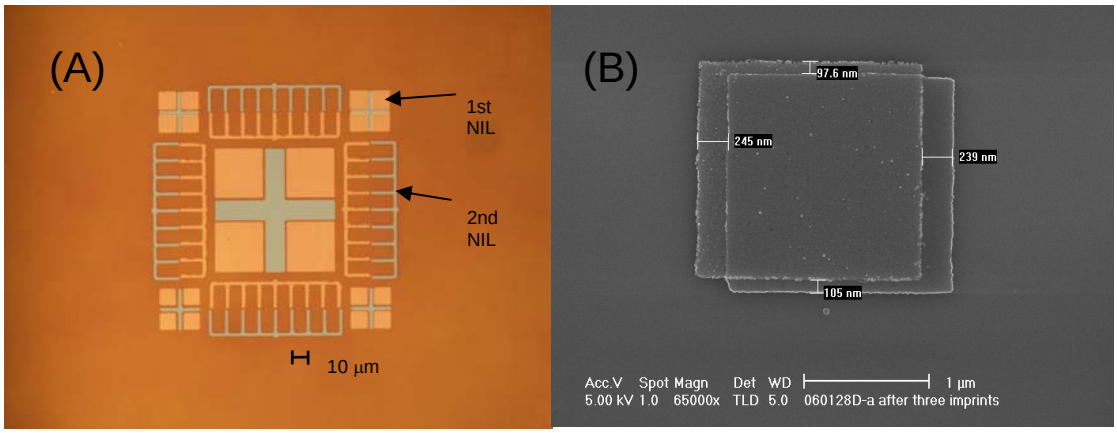


Figure 2. (A) Optical image of the alignment marks from two nanoimprints. It shows the alignment accuracy is better than half micron. (B) SEM image of two square shape patterns fabricated by two nanoimprint and steps. A misalignment of about quarter micron is shown in the image.

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