Liquid Transfer Imprint Lithography: A new route to residual layer thickness control

N. I. Koo, J. W. Kim, M. Otto, C. Moormann, H. Kurz
*AMO GmbH, **A**dvanced **Mi**croelectronic **C**enter **A**achen (AMICA),*
Otto-Blumenthal-Strasse 25, 52074 Aachen, Germany
moormann@amo.de

The control of the residual layer thickness is of utmost importance for the application of nanoimprint technology. Pattern transfer of high resolution features requires thin residual layers and tight control of their thickness tolerances across the patterned area. Pattern density and initial resist thickness variations especially in case of non flat surfaces and thin resist layers have a strong effect on the final thickness distribution and on defect density. Various approaches to minimize the nanoimprint proximity effect[1], like compensating features[2], 3D capacity equalized mold[3] or drop-on-demand coating[4,5] have been presented, but suffer from additional area usage, extreme fabrication or computational complexity.

In this contribution we will present an innovative but simple process solution which separates parameters that have been regarded as conflicting up to now. For example with this approach both complete and defect free stamp filling as well as minimum layer thickness can be achieved.

In so called "Liquid Transfer Imprint Lithography" (LTIL) the cavities of a flexible PDMS stamp are filled completely by imprinting into a homogeneous thick resist layer in a first step. While the resist is still liquid the stamp is peeled off again. We found out that the resist layer is split in the middle leading to a residual layer thickness reduction by a factor of two, while the stamp cavities remain perfectly filled. Consecutive reduction of the layer is possible followed by a transfer print of the patterned resist on the final substrate and subsequent UV-curing. Due to the flexibility of the homogeneous coated stamp even non flat substrates can be printed with extremely thin residual layers, as demonstrated in figure 2.

We will discuss the process conditions and potentials of LTIL and pattern transfer with nanoscale resolution on non flat substrates specifically.

---

1 S Landis, N Chaix , C Gourgon , C Perret and T Leveder, Nanotechnology 17, 2701 (2006)

2 F. Lazzarino, C. Gourgon, P. Schiavone, C. Perret, J.Vac.Sci. Technol. B **22,** 3318 (2004).

3 H. Hiroshima. Microelec.Eng **86,** 611 (2009).

4 M. Melliar-Smith, Proc. SPIE 6517 (Emerging Lithographic Technologies XI), Plenary Paper, (2007).

5 V. Sirotkin, A. Svintsov, S. Zaitsev, Microprocess. Nanotechnol., 2007 Digest of Papers 406 (2007).

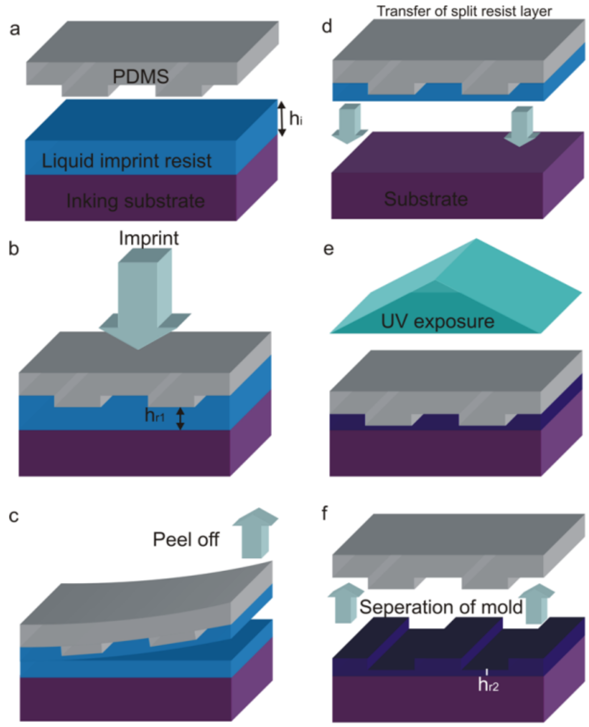

Figure 1: LTIL process sequence scheme: Imprint of a patterned PDMS mold into a liquid resist layer (a), filling mold cavities with the resist (b), Peeling the mold from the liquid layer (c), Transfer of split liquid layer on the PDMS mold onto a substrate (d), Resist curing via UV-exposure (e), Mold separation (f).

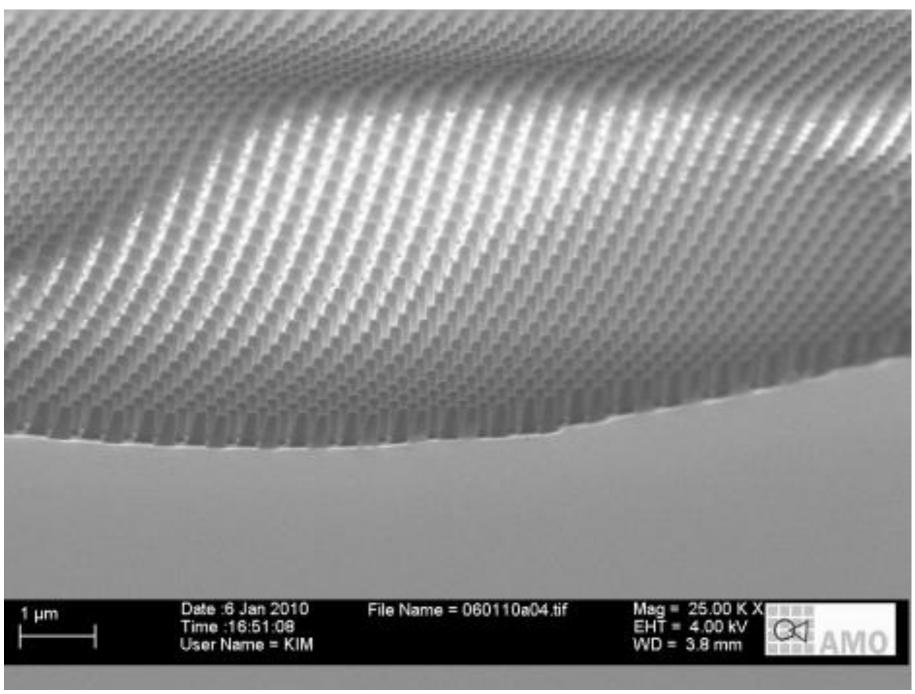

*Figure 2: S*EM images of a 500 nm pitch grating on a heavily curved substrate with nearly zero residual layer thickness.