# IMPRINT software: stamp bending compensation, residual layer and cavities fullness prediction

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One of the most challenging features of the nanoimprint lithography (NIL) process is the control of the imprint quality. As pattern transfer is one of the critical steps involved in the overall NIL process, likely, inhomogeneous residual layers and incomplete cavities fullness would like to be avoided as they will affect negatively in the overall imprint quality.

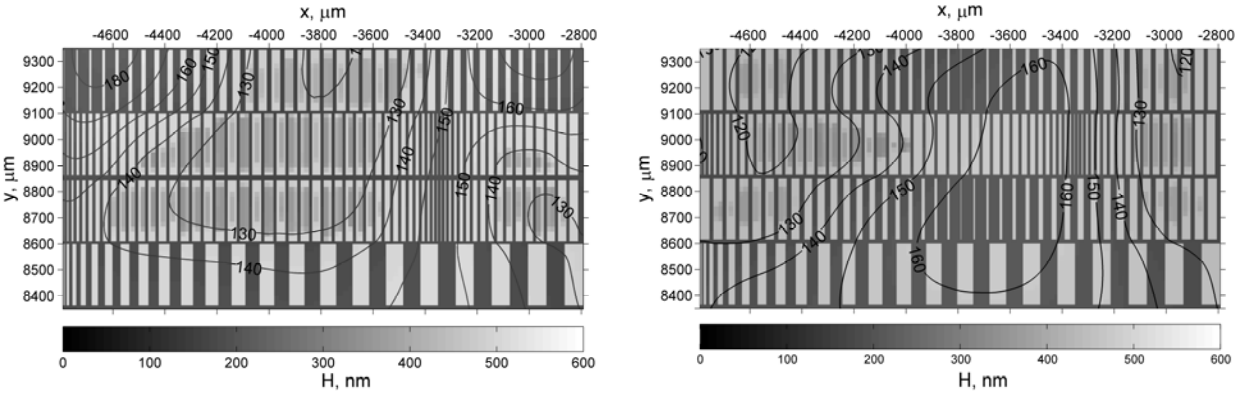
A homogeneous residual layer thickness in nanoimprint lithography (NIL) can be achieved by optimizing the NIL stamp geometry (the distribution of cavities and protrusions, the stamp cavities depth and the stamp thickness) as well as by choosing NIL process parameters (the initial resist thickness, the imprint temperature and the duration of the imprint). This optimization produces the greatest benefit if its implementation is performed before expensive stamp manufacturing starts. To do this requires an effective tool for the simulation of NIL process.

In this work, we review all our results on the use of the IMPRINT software for the residual layer and cavities fullness prediction and for the stamp bending optimization. Our results [1] shown that the IMPRINT software can be used to avoid stamp bending by appropriate design of the stamp architectures. Figure 1 shows our calculated results of the residual layer thickness distribution, due to the elastic bending of the stamp, of the original and a modified stamp design. Both experimental and simulated results of the stamp bending were in very good agreement. The stamp deformation of the optimized ("reordered") structure difference is 40 nm. Thanks to this reordering, the stamp deformation has been reduced by 33% while an elimination of the incomplete filling has been achieved.

Figure 2 shows the influence of the initial resist thickness on the minimum and maximum residual layer thickness for different values of the stamps cavities depth (height). On the same graph, we could see the simulated influence of the initial resist thickness on cavities fullness.

Our latest results on the use of the IMPRINT software for imprint optimization of three-dimensional stamp configurations will also be discussed.

[1] N. Kehagias, V. Reboud, C. M. Sotomayor Torres, V. Sirotkin, A. Svintsov, S. Zaitsev, Microelectron. Eng. 85 (2008) 846–849.



(a) (b)

*Fig 1:* The calculated distribution of the resist thickness H for the original (a) and modified (b) structures with cavities of depth 315 nm. The initial thickness of resist mr-I 8000 is 318 nm. The imprint temperature is 200°C (the resist dynamic viscosity – $3\times10^3$ Pa·s). Black isolines indicate the distribution of the stamp and substrate deformation (numbers signify the elastic displacement in nanometers).

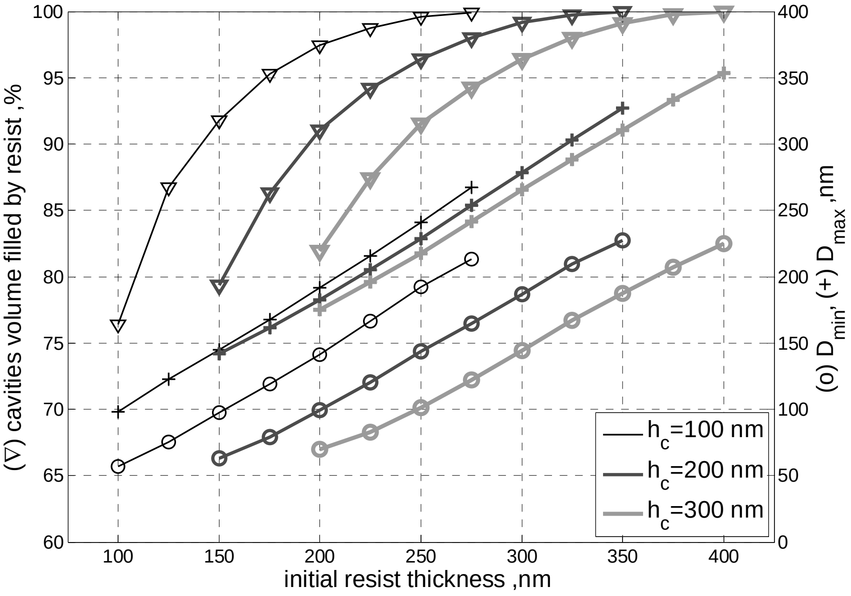


*Fig 2:* The simulated influence of the initial resist thickness on minimal ($D_{min}$) and maximal ($D_{max}$) values of the residual thickness as well as on cavities fullness for the test structure with different cavities depth $h_c$.

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