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Michele Pianigiani, Robert Kirchner, Enrico Sovernigo, Alessandro Pozzato, Massimo Tormen, Helmut Schift

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Effect of nanoimprint on the elastic modulus of PMMA: comparison between standard and ultrafast thermal NIL

Michele Pianigiani[a,b,c,*], Robert Kirchner[d], Enrico Sovernigo[a,b], Alessandro Pozzato[a,b], Massimo Tormen[a,b,*], Helmut Schift[d,*],

[a] *ThunderNIL srl, via Foscolo 8, 35131 Padova, Italy*
[b] *IOM-CNR Area Science Park, Basovizza, S.S. 14,Km. 163.5, 34149 Trieste, Italy*
[c] *Università degli Studi di Trieste, Piazzale Europa, 34127 Trieste, Italy*
[d] *Paul Scherrer Institut, Laboratory of Micro and Nanotechnology, 5232 Villigen PSI, Switzerland*

Abstract

This paper is focused on the understanding of the effect of the nanoimprint lithography process on the elastic modulus of thin, thermoplastic films. In particular, we present the comparison between the standard and an ultrafast thermal NIL technology as well as the way both processes affect the top surface of poly(methyl methacrylate) (PMMA). The PeakForce QNM™ (Quantitative Nanomechanical Property Mapping) scanning probe technique was used to determine the Young's modulus of PMMA by comparison with a polystyrene standard. We demonstrate that imprinted PMMA, regardless of the used method, shows a 9-fold increase of Young's modulus compared to non-imprinted PMMA at least in the top 3-5 nm thick surface layer. This important finding proves that the ultrafast process with much higher temperatures, but also with much shorter process times, leads to elastic surface properties that are comparable to those of PMMA imprinted with the standard process. We have confirmed that annealing alone does not significantly influence the Young's modulus.

Keywords: Thermal NIL, pulsed-NIL, PMMA, PeakForce AFM, Young's modulus

[*] Corresponding authors.
Michele Pianigiani: Tel.: *+ 39 0403758769* *e-mail: michele.pianigiani@thundernil.com*
Helmut Schift: Tel.: *+41 56 310 28 39* *e-mail: helmut.schift@psi.ch*
Massimo Tormen: Tel.: *+ 39 0403758416* *e-mail: massimo.tormen@thundernil.com*