Deformation of Stamp Features with Slanted Walls During Microcontact Printing

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Abstract

Microcontact printing is a method for depositing patterns of thin films or molecular monolayers on surfaces using a polydimethylsiloxane (PDMS) stamp for selective mechanical contact (Figure 1). Undesired deformation of the stamp features during printing affects printed pattern quality (Figure 2). Hence, stamps need to be well--designed to prevent erroneous prints.

Existing investigations identify the collapse modes for deformation of stamp features, develop models to predict conditions leading to stamp collapse, and reveal interdependency of these on stamp geometry [1--7]. Results of these studies are limited to stamps with straight--walled features only. However, recent work by Nietner [8] has demonstrated the ability to create micro--features with adjustable wall angles.

In this study, deformation simulations are extended to cover the stamp features with slanted walls using structural mechanics module and nonlinear structural materials module in COMSOL® software (Figure 3). Simulation results indicate that critical pressure for roof collapse increases with increasing sidewall angle and spacing of the stamp features.

Reference

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Figures used in the abstract

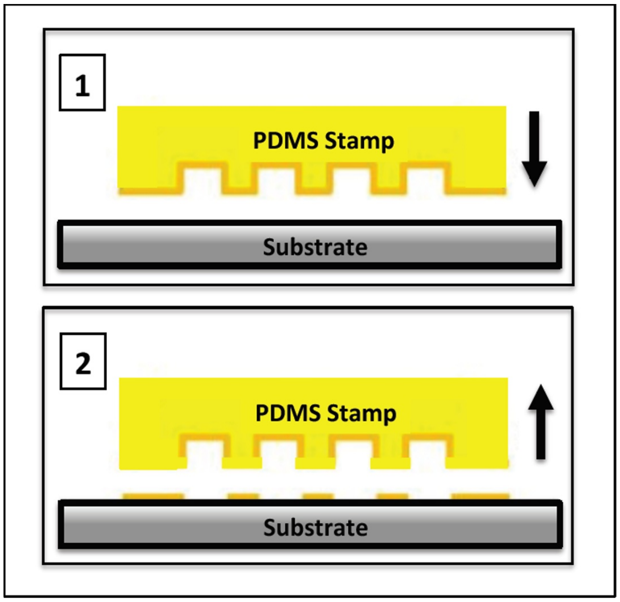


Figure 1

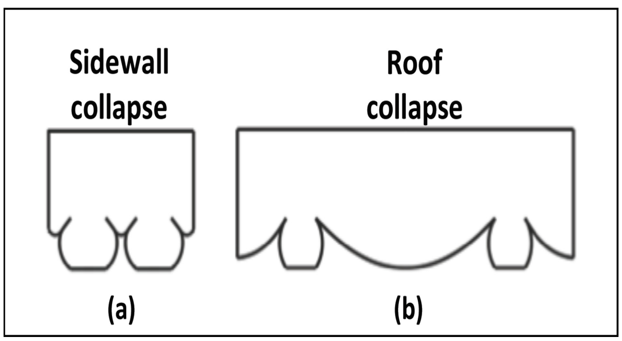
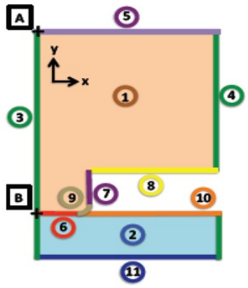


Figure 2



Domain, Boundary, Point	Condition
1	Hyperelastic material - Initial displacement=0 - Initial velocity=0
2	Fixed constraint - Initial displacement=0 - Initial velocity=0
(10):(6, 7, 8, 9)	Contact couple 1 (zero friction coefficient)
(8):(9,7)	Contact couple 2 (zero friction coefficient)
3, 4	Symmetry
5	Prescribed displacement (displaced in negative y direction with 1 micron increments till roof collapse occurs)
6, 7, 8, 9, 10, 11	Free
B	Fixed constraint
A	Prescribed displacement - x-displacement=0 - y-displacement=unspecified

Figure 3