Theoretical and Experimental Validation of Micro Hot Embossing on Polymeric Substrates

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Abstract

Micro hot embossing on a large area polymeric substrates using roll-to-roll (R2R) mode has been considered as one of the most promising technologies that can offer continuous fabrication of large area polymeric substrates. Besides continuous operation, roll-to-roll (R2R) process offers advantages such as low forming load and higher replication accuracy. Consequently, R2R embossed polymeric substrates comprising micron and nanoscale features are widely used in the area such as organic solar cells, flexible displays, biomedical devices and so on. Several studies suggested that temperature, pressure and embossing time are the main parameters that influence replicated features in terms of its accuracy and fidelity. In this paper, we present a novel method of determining temperature distribution across the polymer film using an analytical method and a simulation created with the COMSOL Multiphysics® software. Finally, an attempt has been made to correlate simulation results with the rheological and mechanical behavior of polymer thereby providing a deeper understanding of R2R hot embossing process.