Fabrication and modelling of injection moulded all-polymer capillary microvalves for passive microfluidic control - DTU Orbit (10/12/2018)

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Rapid prototyping is desirable when developing products. One example of such a product is all-polymer, passive flow controlled lab-on-a-chip systems that are preferential when developing low-cost disposable chips for point-of-care use. In this paper we investigate the following aspects of going from rapid prototyping to pilot (mass) production. (1) Fabrication of an all-polymer microfluidic system using a rapid prototyped master insert for injection moulding and ultrasonic welding, including a systematic experimental characterisation of chip featured geometric capillary microvalve test structures. (2) Numerical modelling of the microvalve burst pressures. Numerical modelling of burst pressures is challenging due to its non-equilibrium nature. We have implemented and tested the level-set method modified with a damped driving term and show that the introduction of the damping term leads to numerically robust results with limited computational demands and a low number of iterations. Numerical and simplified analytical results are validated against the experimental results. We find that injection moulding and ultrasonic welding are effective for chip production and that the experimental burst pressures could be estimated with an average accuracy of 5% using the presented numerical model.