MICRO MOULDING OF POLYMER MICROFLUIDIC CHIPS USING NICKEL INJECTION MOULD FABRICATED VIA PROTON BEAM WRITING AND UV LITHOGRAPHY

Zhao Jianhong[1], Jeroen A van Kan[2], Wang Yinghui[2], Sebastian Emil Wagner[1], Piravi Perumal Malar[2], Kong Wai Tuck[1]

1Singapore Institute of Manufacturing Technology, 638075 Singapore, Singapore and 2Centre for Ion Beam Applications, Department of Physics, National University of Singapore, 19260 Singapore, Singapore

Polymer microfluidic devices have attracted considerable research and industrial interests in recent years as they can be mass manufactured through the injection moulding process at a low cost for disposable applications in diagnostic, genetic analysis, drug development and food quality analysis. To manufacture polymer devices through the injection moulding process, high quality injection moulds with micro features down to micro and even nano meters are often required. There are limitations to use the traditional machining method in fabricating such micro moulds. The lithographic and nickel plating method, on the other hand, is very suitable for replicating micro structures on nickel substrate. However, to use nickel microstructure as mould insert for injection moulding applications, there are certain strength, rigidity and dimensional requirements on nickel plated inserts. For many moulding applications, nickel inserts with a thickness of over 2 mm are often required for easy and reliable fitting into mould bases. In this paper, proton beam writing (PBW) and UV lithography techniques are combined to manufacture 2 mm thick nickel moulds with sub-10 µm fine features for injection moulding applications. PBW is capable of writing micro and nano features with straight and smooth sidewalls, while UV lithography has the advantage of large area structuring through a mask. Nickel inserts with thicknesses of over 2 mm have been manufactured and used for moulding of polymer microfluidic biochips with fine micro channel features using a micro moulding machine.