Fast prototyping of injection molded polymer microfluidic chips

We present fast prototyping of injection molding tools by the definition of microfluidic structures in a light-curable epoxy (SU-8) directly on planar nickel mold inserts. Optimized prototype mold structures could withstand injection molding of more than 300 replicas in cyclic olefin copolymer (COC) without any signs of failure or release. The key parameters to avoid mold failure are maximum adhesion strength of the epoxy to the nickel insert and minimum interfacial energy of the epoxy pattern to the molded polymer. Optimal molding of microstructures with vertical sidewalls was found for nickel inserts pre-coated by silicon oxide before applying the structured epoxy, followed by coating of the epoxy by a fluorocarbon layer prior to injection molding. Further improvements in the mold stability were observed after homogeneous coating of the patterned epoxy by a second reflowed layer of epoxy, likely due to the resulting reduction in sidewall steepness. We employed the latter method for injection molding bondable polymer microfluidic chips with integrated conducting polymer electrode arrays that permitted the culture and on-chip analysis of cell spreading by impedance spectroscopy.

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