RAPID FABRICATION OF COC MICROFLUIDIC CHIPS USING ADHESIVE BONDING

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Microfluidic chip technologies provide a new alternative for in vitro drug testing on a mass scale, biofilm research, and accessible screening devices for diseases [1]. With advances in materials science and microfluidic device manufacturing over the past two decades, microfluidic technologies have been increasingly adopted in drug testing and cosmetics, thereby reducing reliance on animal testing in these applications [2]. Therefore, there is a growing need for rapid, reliable, scalable fabrication approaches. Currently, most microfluidic chips are fabricated using polydimethylsiloxane (PDMS). However, PDMS has notable limitations, including absorption of small hydrophobic molecules such as nile red and rhodamine B, as well as low mechanical strength that can lead to channel deformation and inaccurate metrology. In addition to these intrinsic material drawbacks, PDMS fabrication involves manual steps like mixing, degassing, and curing, resulting in batch variability and unsuitability for mass production. To address these challenges, a cyclic olefin copolymer (COC) based microfluidic chip platform is presented. COC is a highly chemically resistant optically transparent thermoplastic, making it ideal for reproducible quantitative analysis. The objective of this work was the development of a rapid, low-barrier fabrication method for COC-based microfluidic chips. Using adhesive bonding combined with simple 3D-printed components, complete chip fabrication can be achieved in under 30 minutes with minimal training and materials, enabling rapid prototyping.

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[2] D. E. Ingber, “Human organs-on-chips for disease modelling, drug development and personalized medicine,” Nat. Rev. Genet., vol. 23, pp. 467–491, 2022, doi: 10.1038/s41576-022-00466-9.