

Electronic Supporting Information for

Indirect fabrication of versatile 3D microfluidic device by rotating plate combined 3D printing system

Dong-Heon Ha^{1¶}, Dong-Hyeon Ko^{2¶}, Jin-oh Kim^{3¶}, Do Jin Im⁴, Byoung Soo Kim¹, Soo-Young Park⁴, Steve Park³, Dong-Pyo Kim^{2&}, and Dong-Woo Cho^{1*&}

¹ Department of Mechanical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Gyeongbuk, Korea

² Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Gyeongbuk, Korea

³ Department of Materials Science and Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea

⁴ Department of Chemical Engineering, Pukyong National University, Busan, Korea

⁵ Department of Polymer Science and Engineering, Kyungpook National University, Daegu, Korea

Corresponding E-mail: dwcho@postech.ac.kr

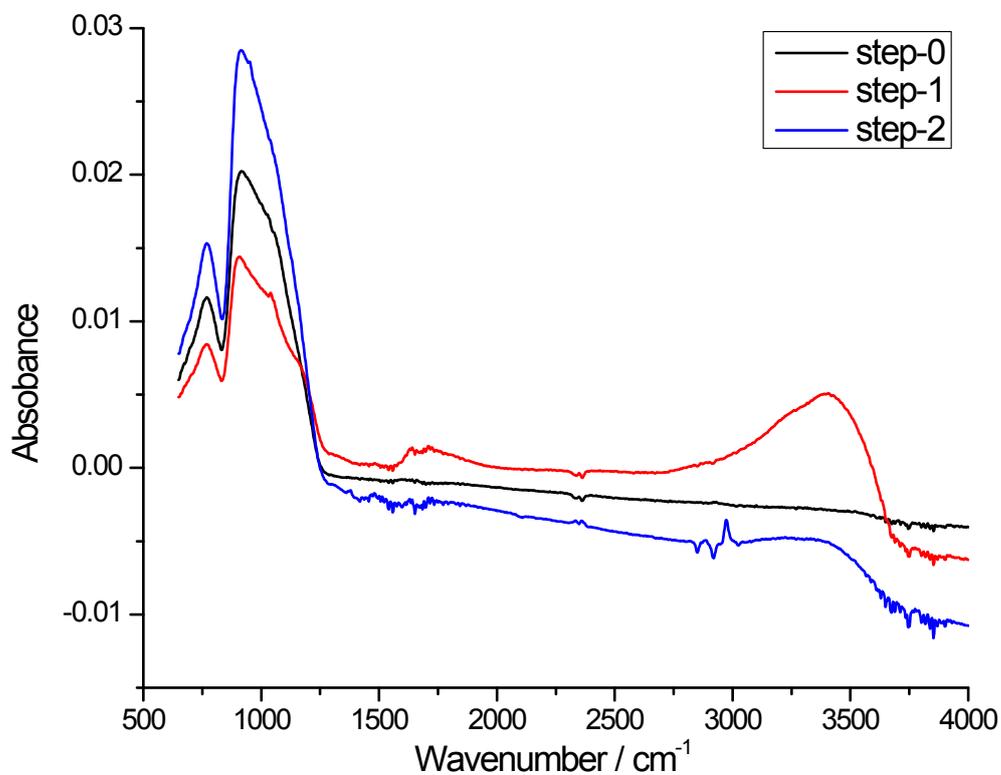


Figure S1. Attenuated Total Reflection (ATR) spectrum for immobilizing Pd catalyst on glass surface. Step 0: Bare glass. Step 1: Hydroxylated surface by treating with Piranha solution, 3,300 cm⁻¹ peak for -OH group. Step 2: Amine functionalized surface by treating with APTES (aminopropyltriethoxysilane) to the hydroxylated surface, 2,900 cm⁻¹ peak for -NH₂ group.

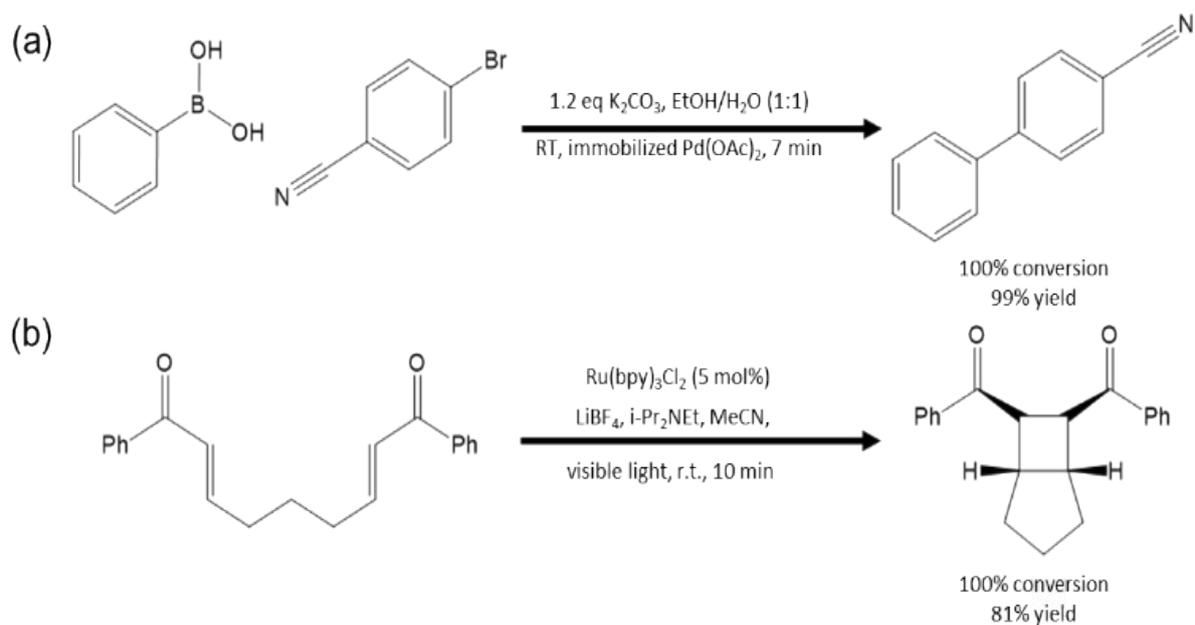


Figure S2. Schemes of model chemical reactions to test the fabricated fluoropolymer-glass microreactor. (a) Suzuki coupling reaction at room temperature in the Pd catalyst immobilized linear microchannel (600 μm wide, 200 mm long). (b) Photochemical C-N coupling reaction at room temperature under a flat LED light source (600 μm wide, 200 mm long).

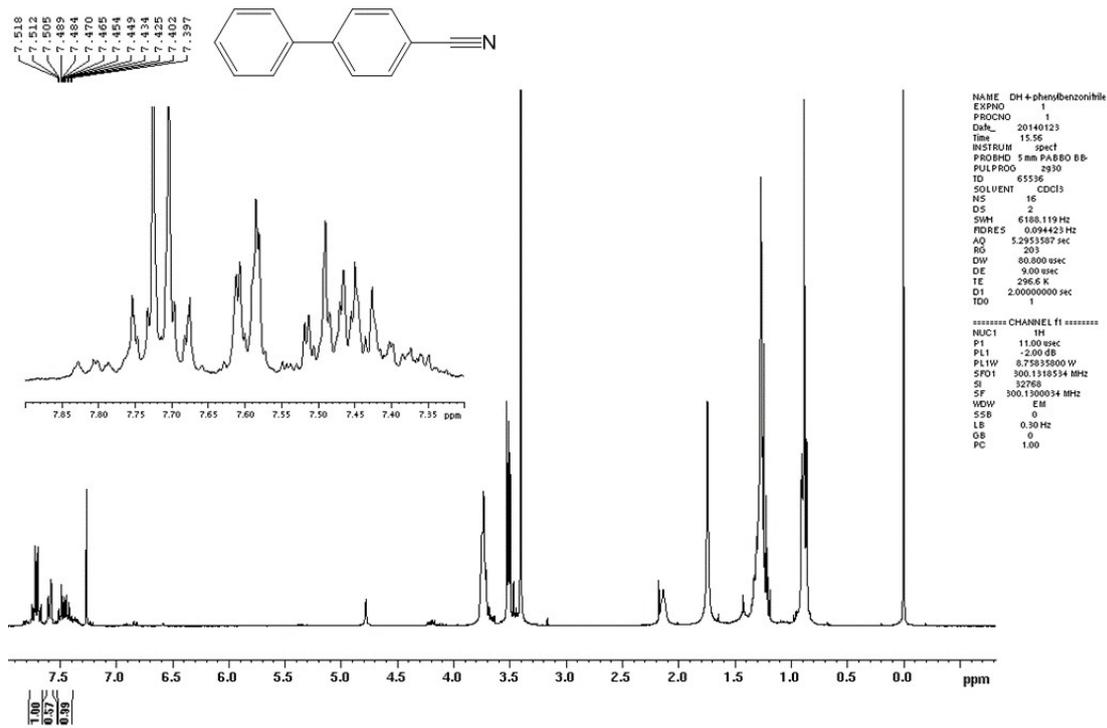


Figure S3. ^1H NMR spectrum of 4-phenylbenzonitrile in CDCl_3 as a product of Suzuki coupling reaction.

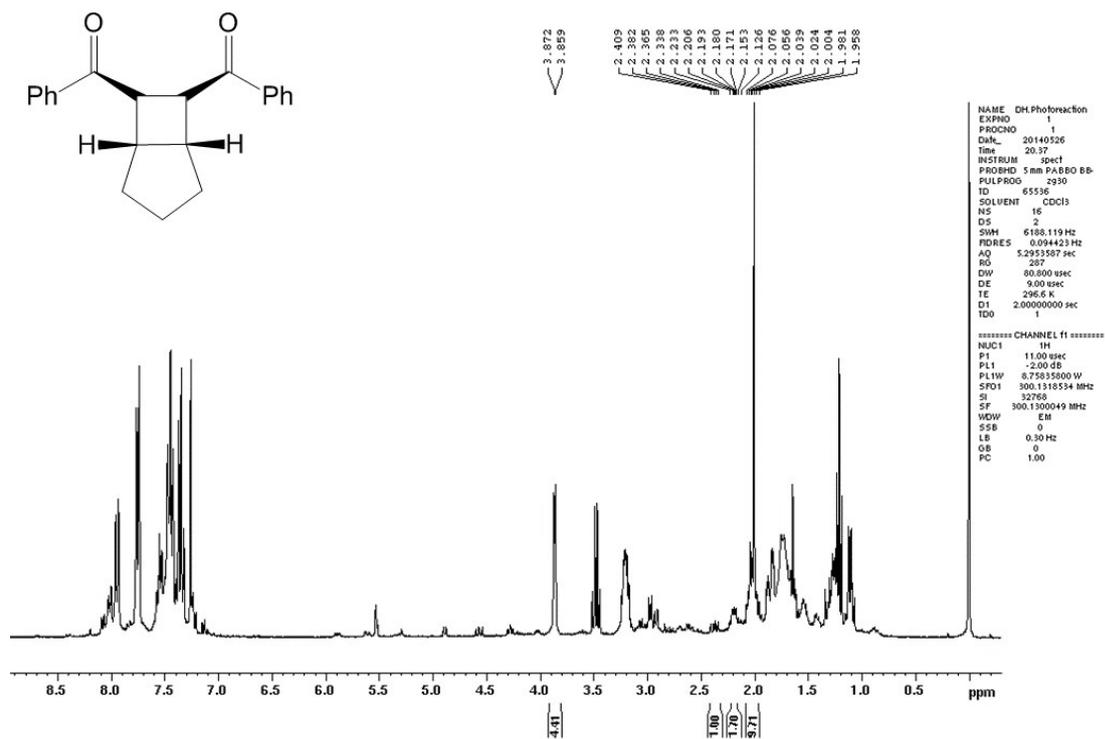


Figure S4. ¹H-NMR spectrum of (1R,5S,6R,7S)-bicyclo[3.2.0]heptane-6,7-diylbis(phenylmethanone) in CDCl₃ as a product of photochemical C-N coupling reaction.

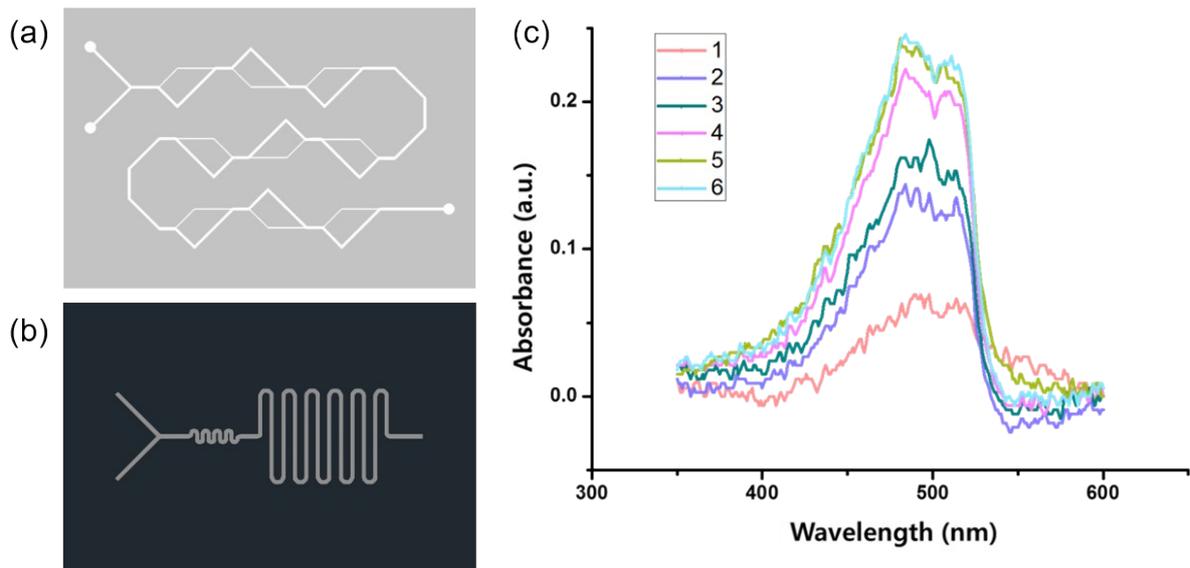


Figure S5. (a) Scheme of asymmetric splitting-merging type of micromixer (width: 600 μm , height: 130 μm , length: two inlets 21.2 mm, larger main line 267.2 mm, and 9 smaller lines 109.3 mm). (b) Scheme of Y-shaped serpentine microchannel (width: 600 μm , height: 100 μm , length: 234.5 mm), a hybrid PDMS-glass microchip was fabricated by conventional soft-lithography technique. (c) UV-Vis absorbance spectrum of n-heptane solution containing different amount of Nile red dye, which was collected from an asymmetric splitting-merging type of micromixer outlet at various flow rates (1: no flow, 2: 40 $\mu\text{L/ml}$, 3: 80 $\mu\text{L/ml}$, 4: 120 $\mu\text{L/ml}$, 5: 160 $\mu\text{L/ml}$, 6: 200 $\mu\text{L/ml}$.)

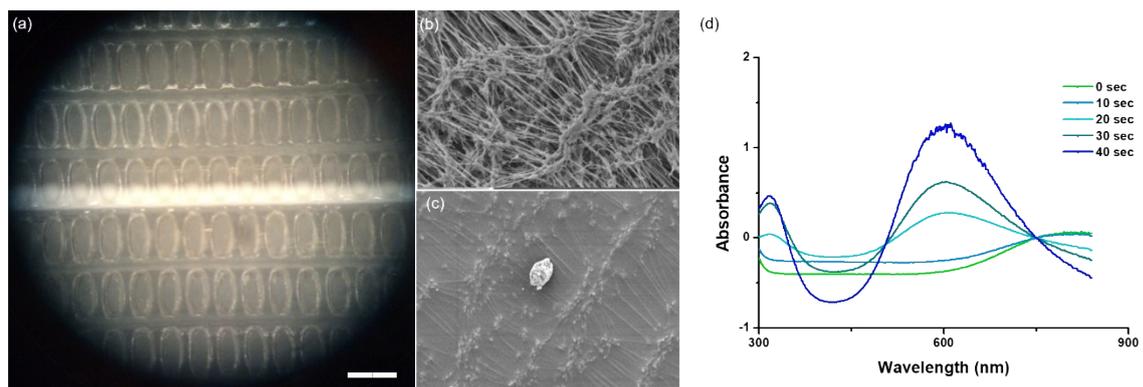


Figure S6. (a) Microscopic image of microchannel (white) in the PTFE membrane-embedded dual-channel microreactor fabricated by SGP process. (Scale bar: 1 mm). Cross-section of PTFE membrane pore: (b) before and (c) after filling by PFPE resin. (d) Illustration of gas-liquid reaction set.