Reaction Chemistry & Engineering

Supporting Information

Design of Novel Dual Function Membrane Microreactor for Liquid-Liquid-Liquid Phase Transfer Catalysed Reaction: Selective Synthesis of 1-Naphthyl Glycidyl Ether

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Dual Function Membrane Microreactor (DFMMR) System

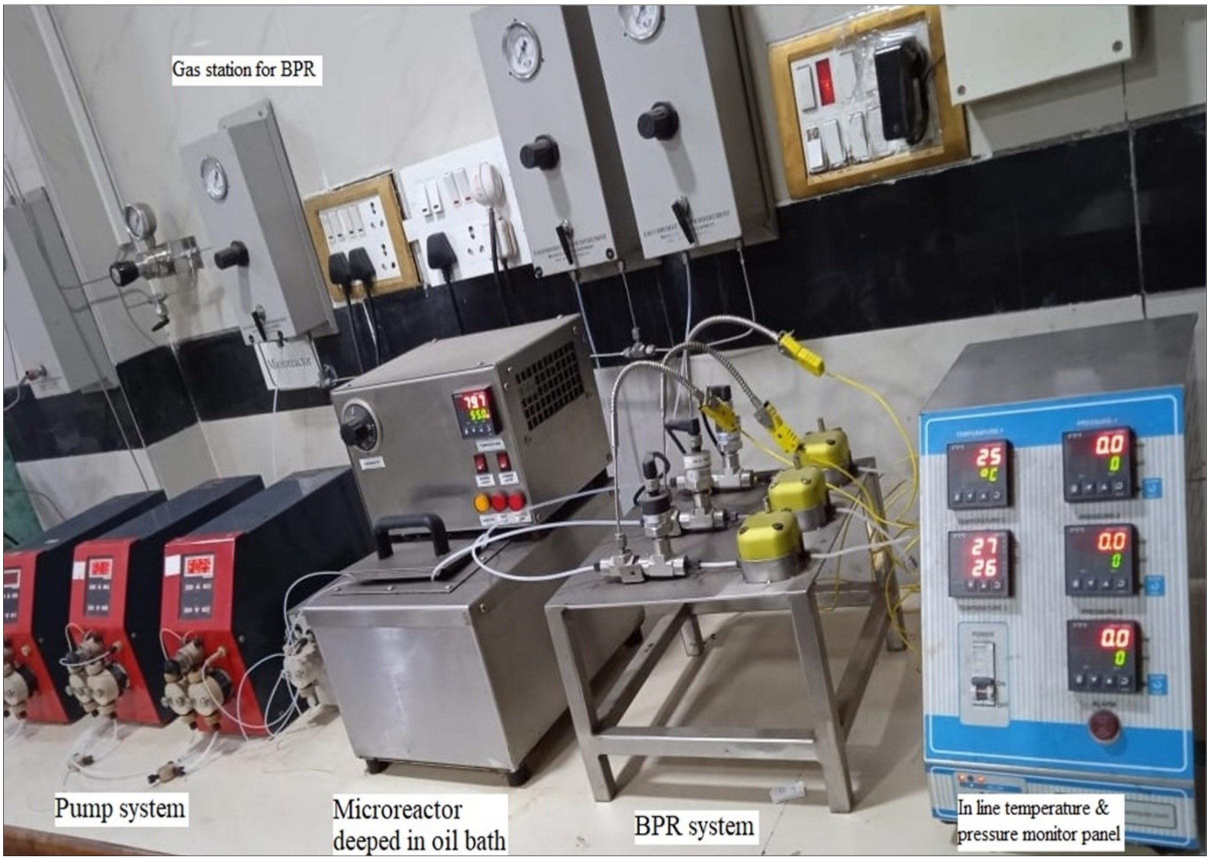

Figure S1. Actual photo of the dual function microreactor system

Figure S2. Dual function microreactor deep in the oil bath.

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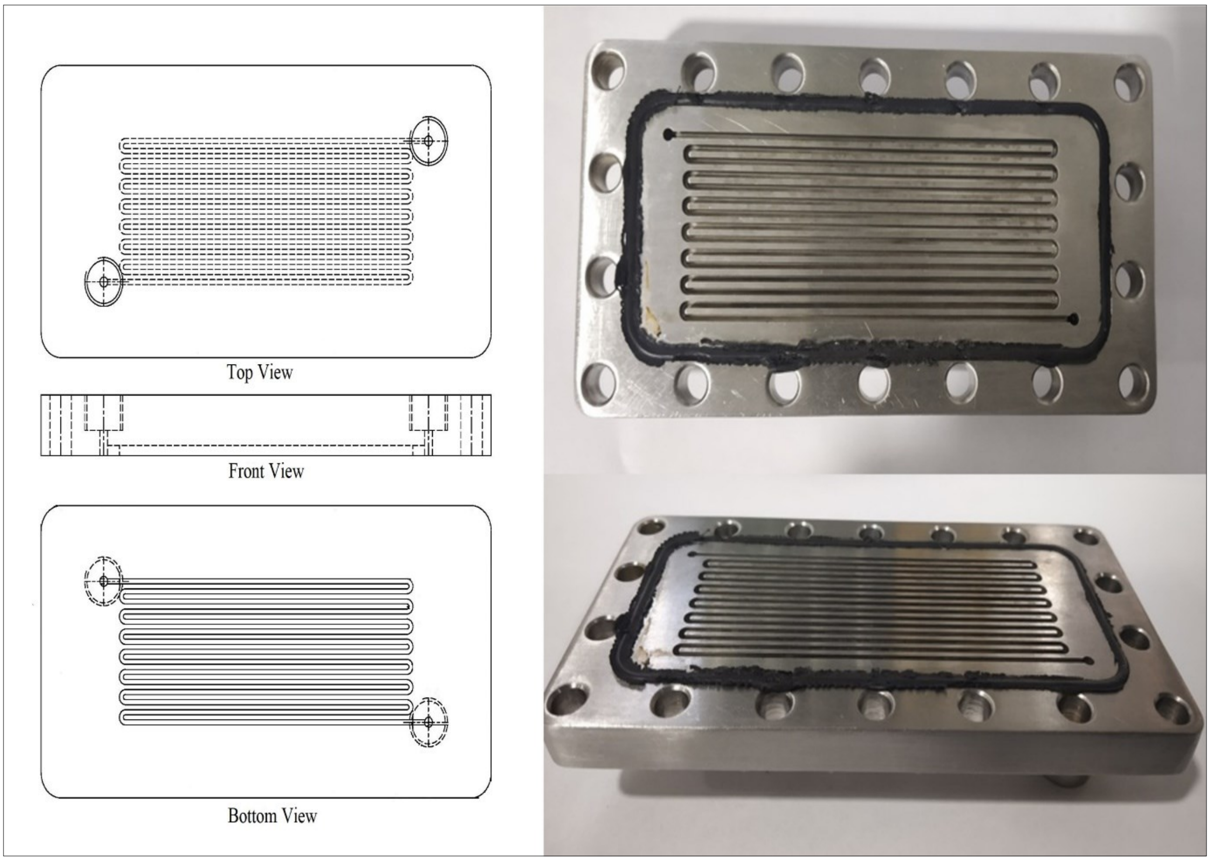


Figure S3. Schematic diagram of the upper plate microchannels.

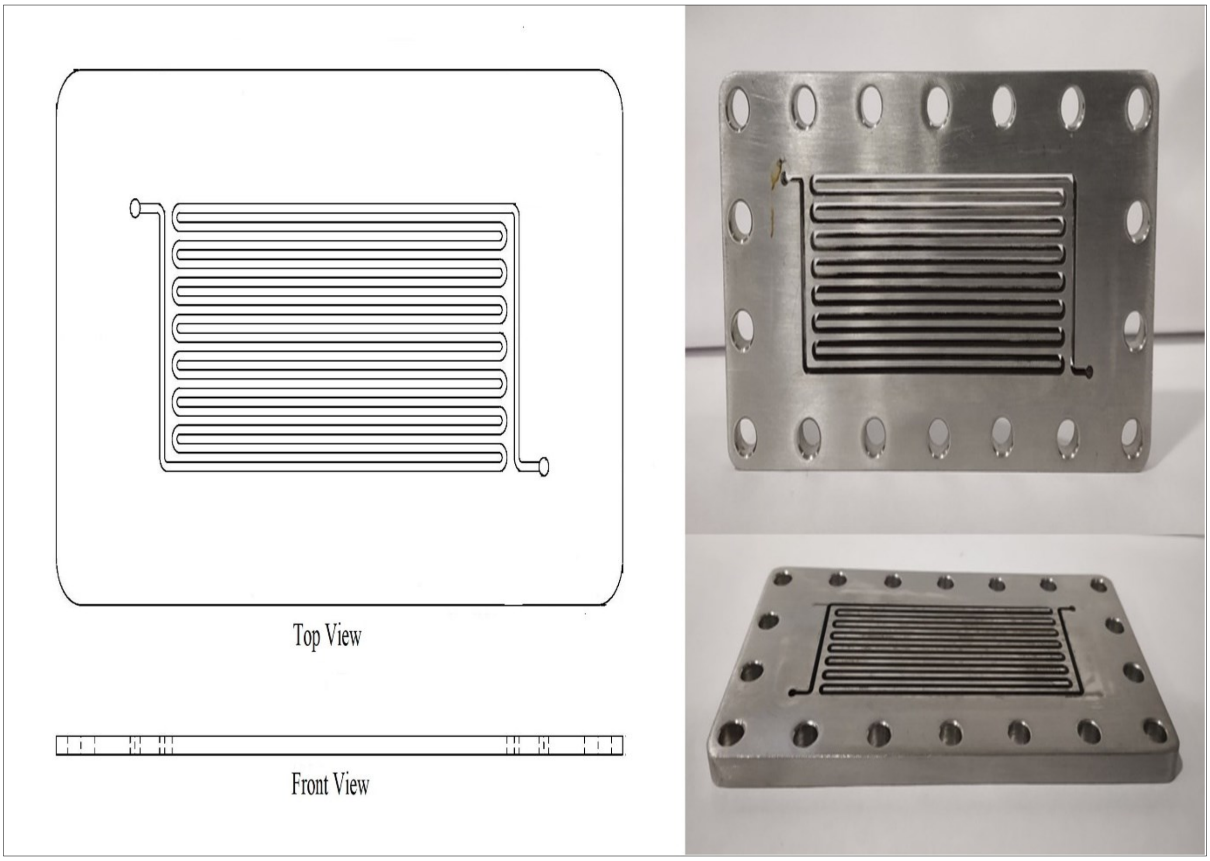


Figure S4. Schematic diagram of the middle plate microchannels.

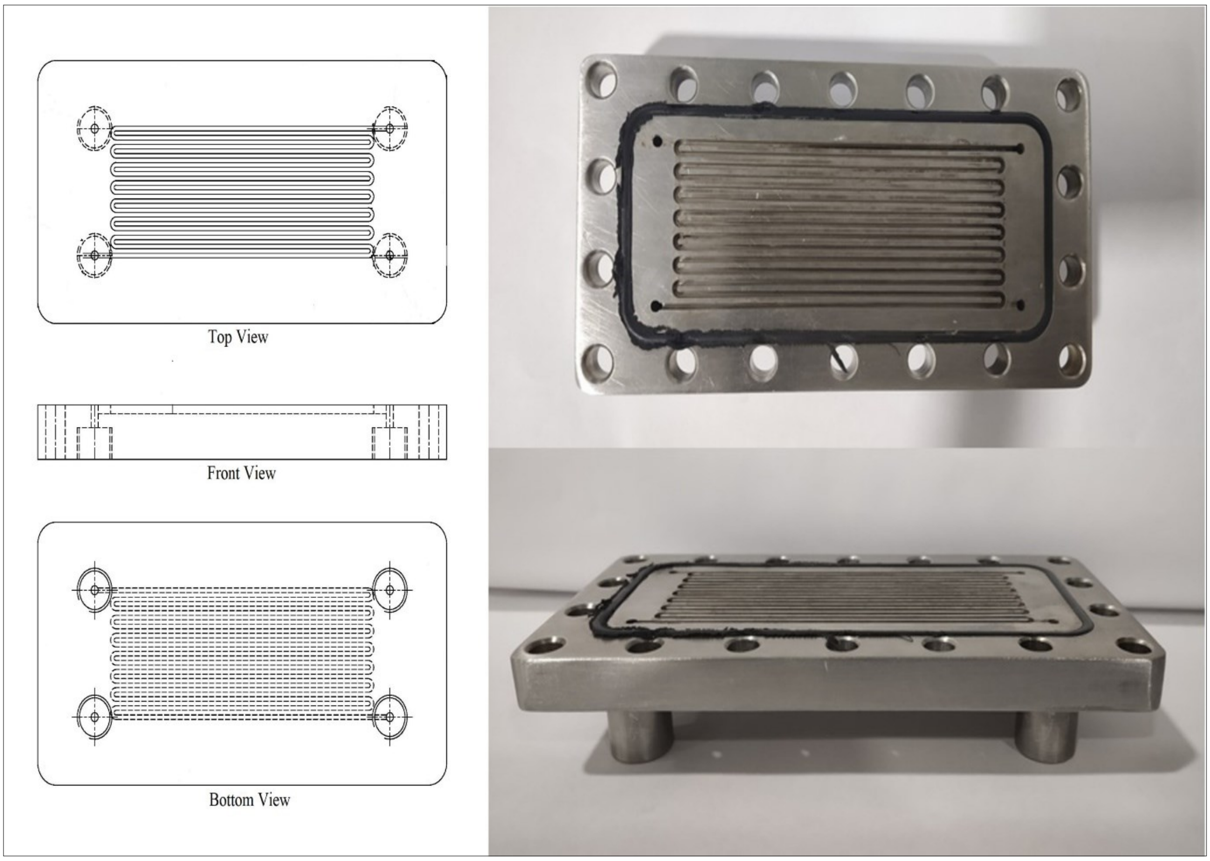


Figure S5. Schematic diagram of the lower plate microchannels.

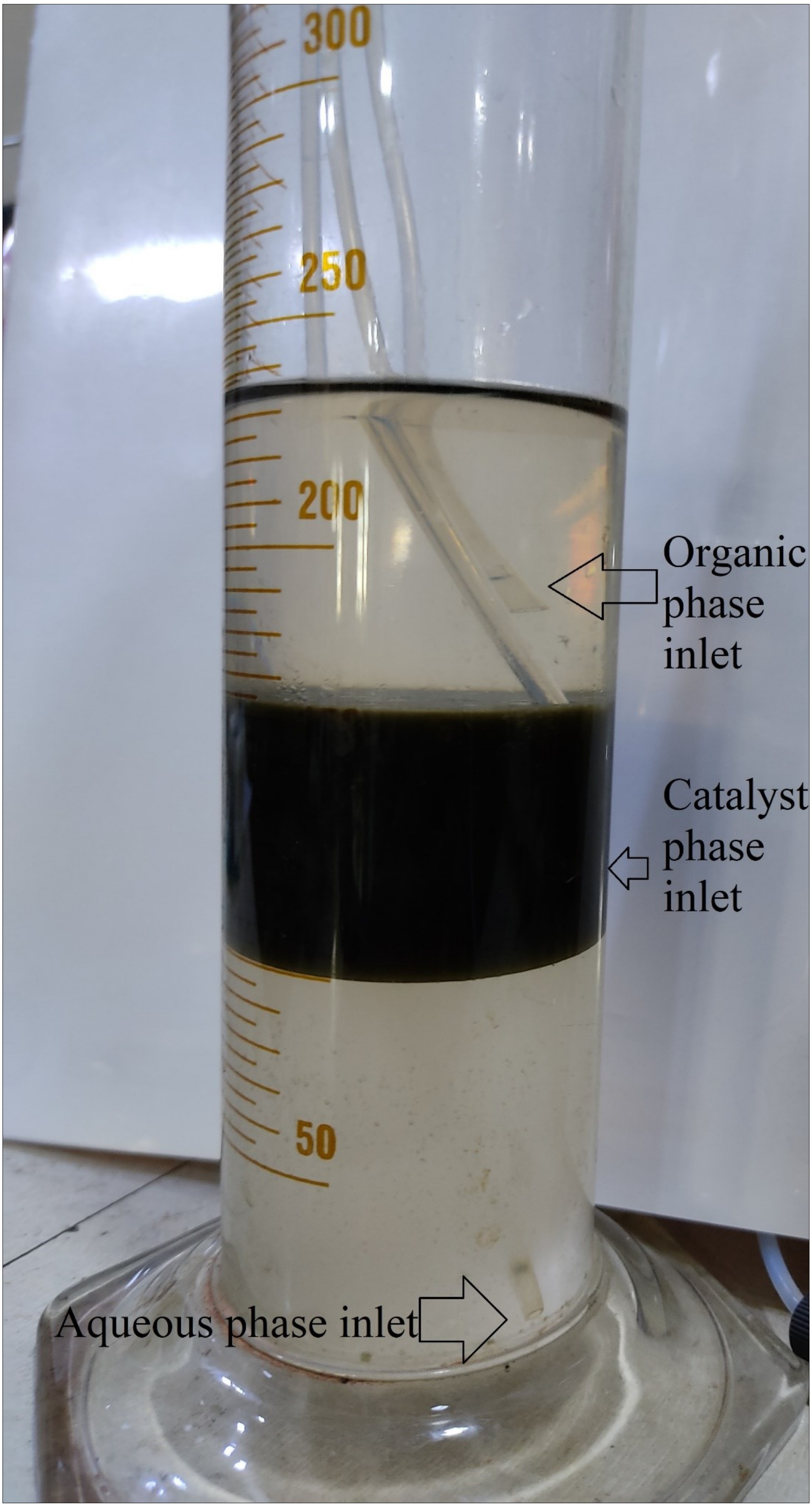

300
250
200
50
Organic phase inlet
Catalyst phase inlet
Aqueous phase inlet

Figure S6. Actual photogrphs of the feed vessel.

GC analysis

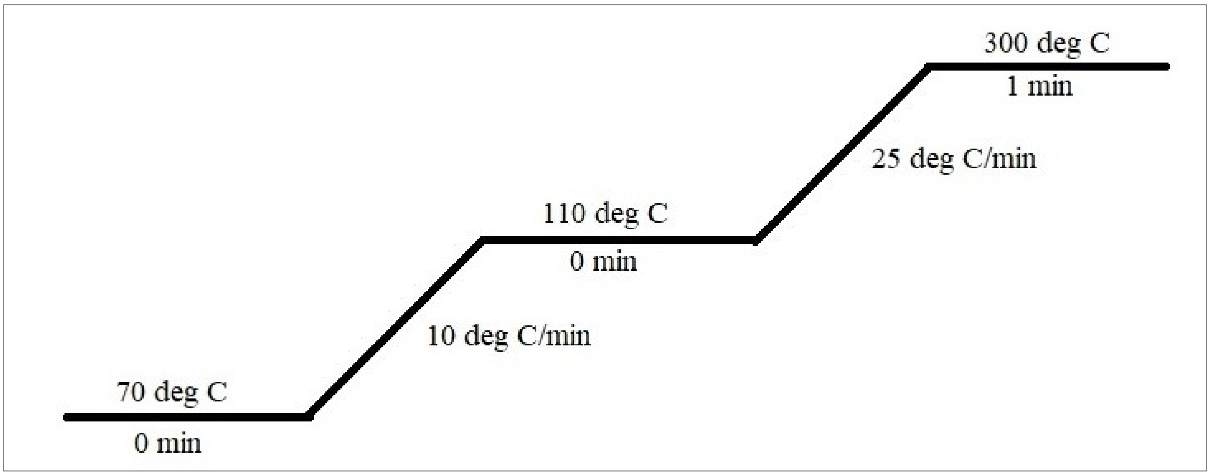


Figure S7. GC method.

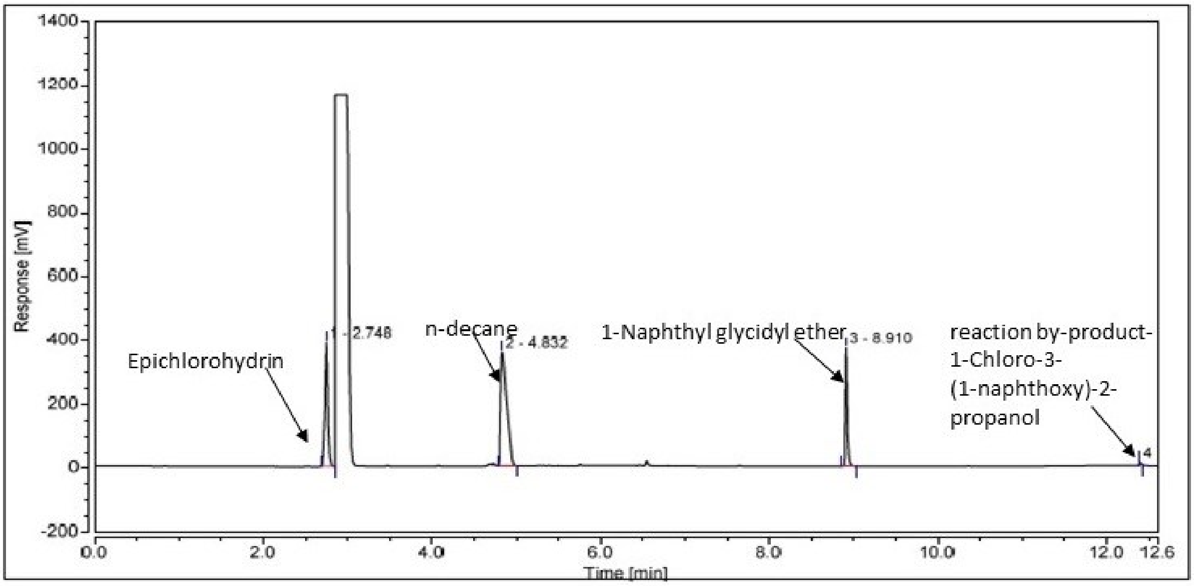
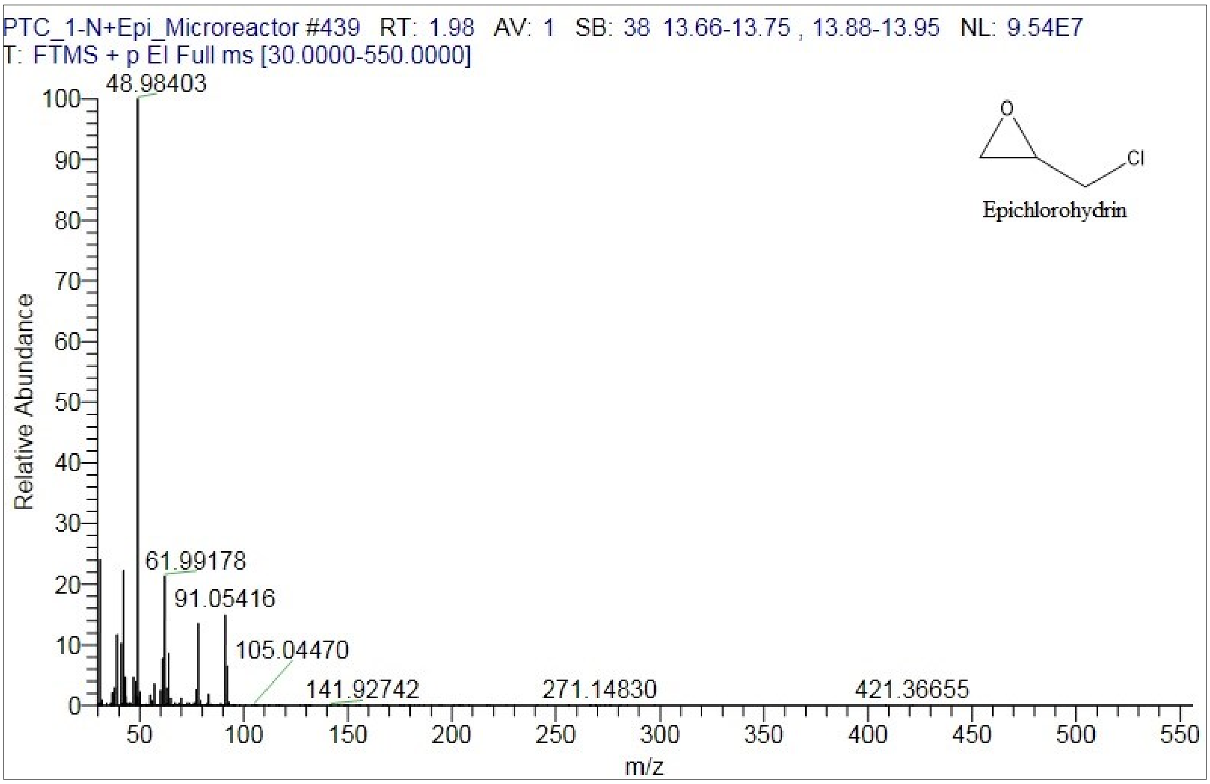


Figure S8. Typical GC chromatogram of reaction mass.

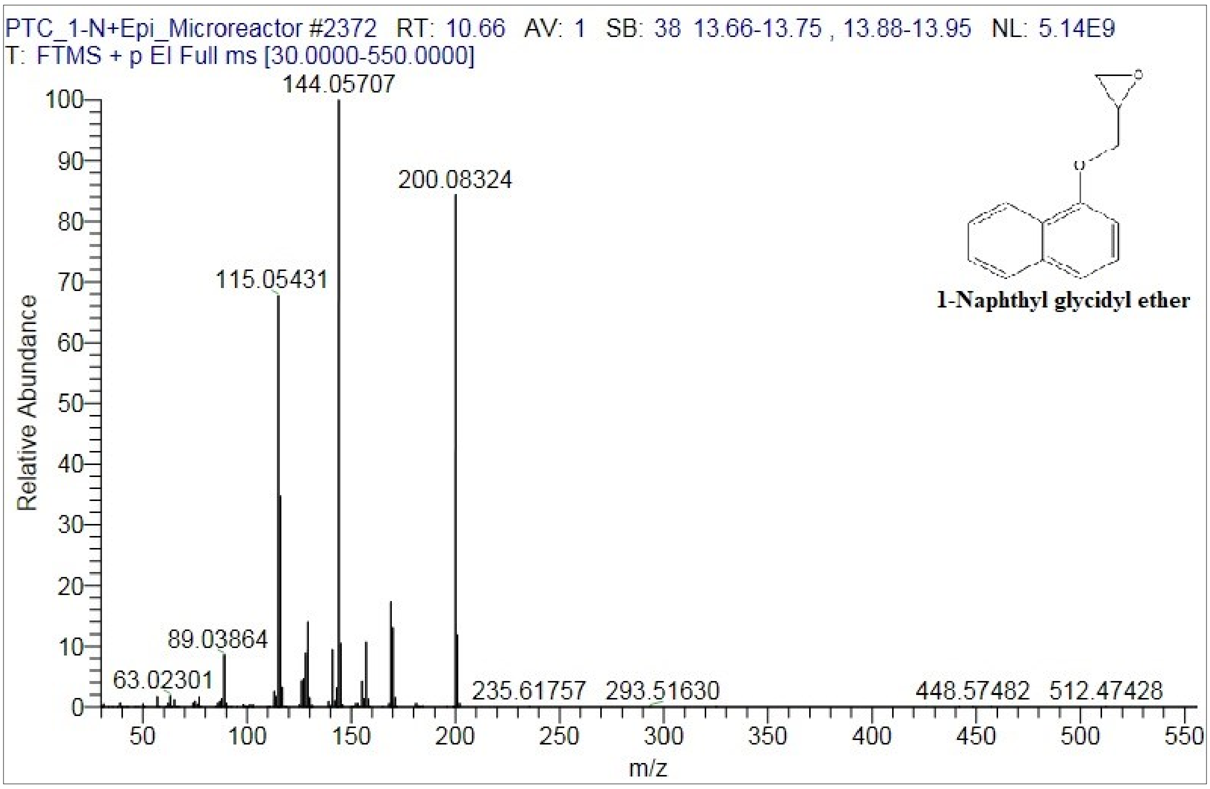
GCMS analysis

The Thermo Scientific Q Exactive Orbitrap GC-MS (HRMS) was used for the confirmation of the product. Following were the MS spectrums for all the GC peaks, including A) Epichlorohydrin, B) 1-Naphthyl glycidyl ether, C) reaction by-product- 1-Chloro-3-(1-naphthoxy)-2-propanol, D) n-Decane.

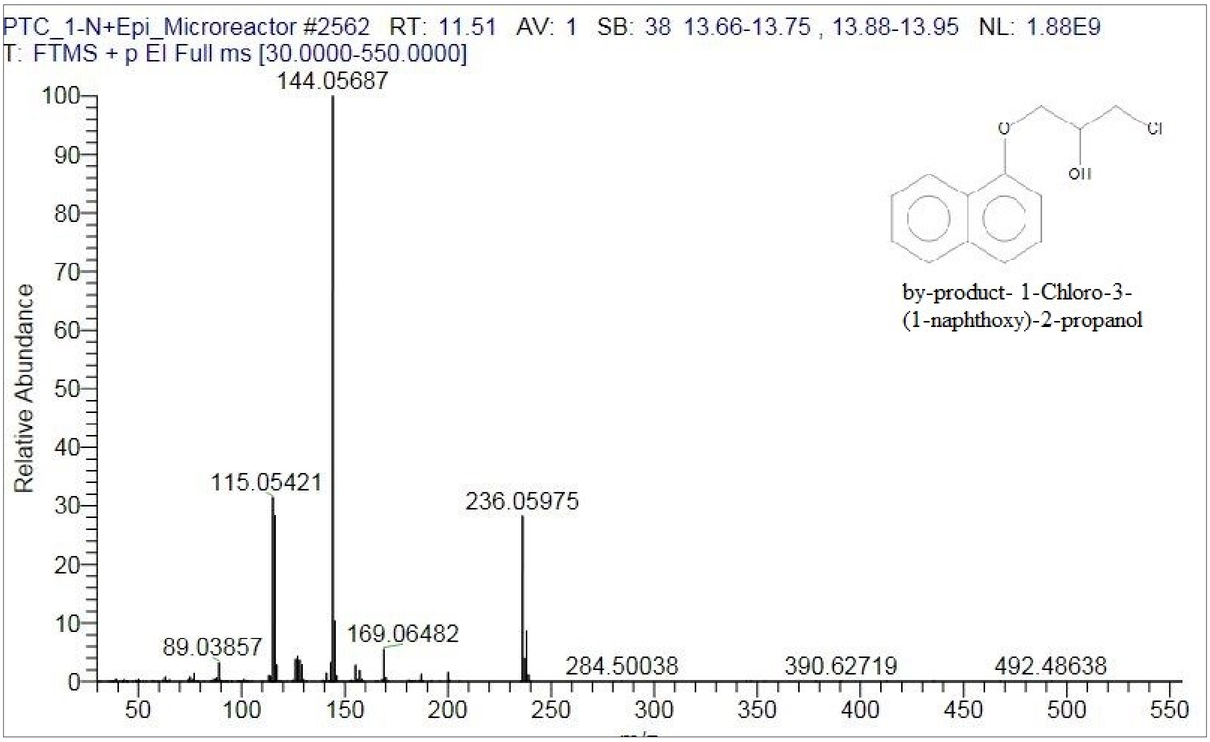
A) Epichlorohydrin



B) 1-Naphthyl glycidyl ether



C) Reaction by-product- 1-Chloro-3-(1-naphthoxy)-2-propanol



D) n-Decane.

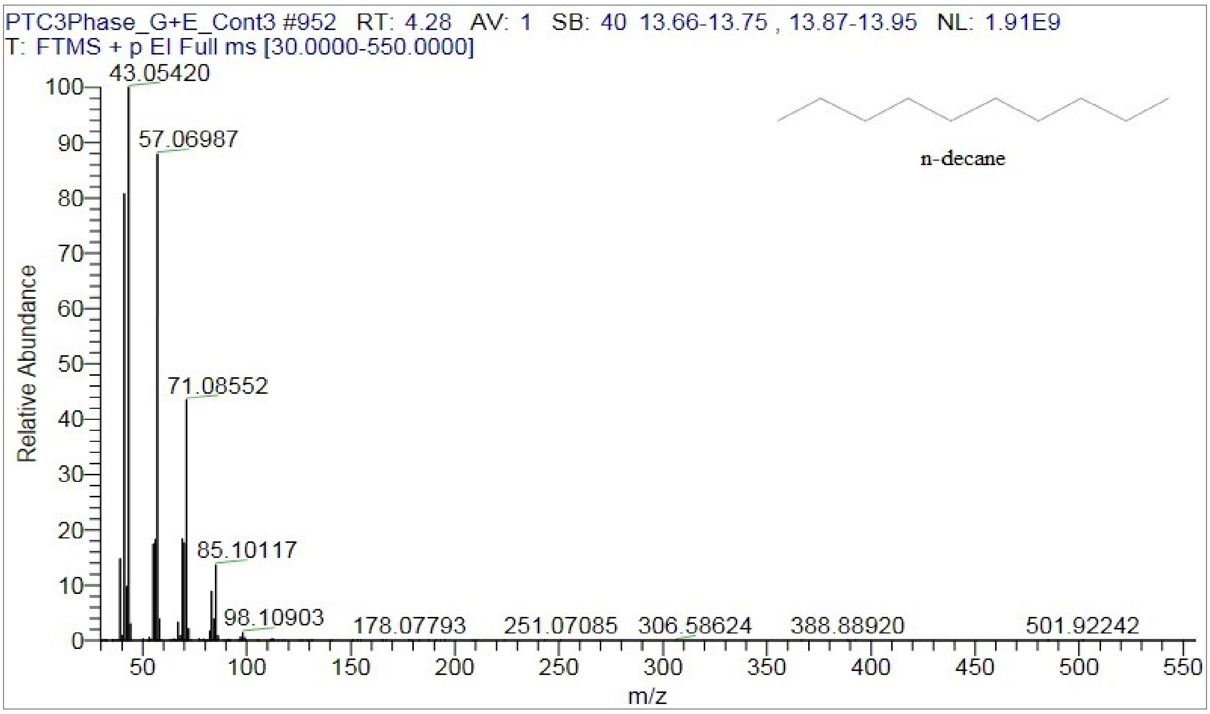


Figure S9. GCMS spectra of A) Epichlorohydrin, B) 1-Naphthyl glycidyl ether, C) reaction by-product- 1-Chloro-3-(1-naphthoxy)-2-propanol, and D) n-Decane.

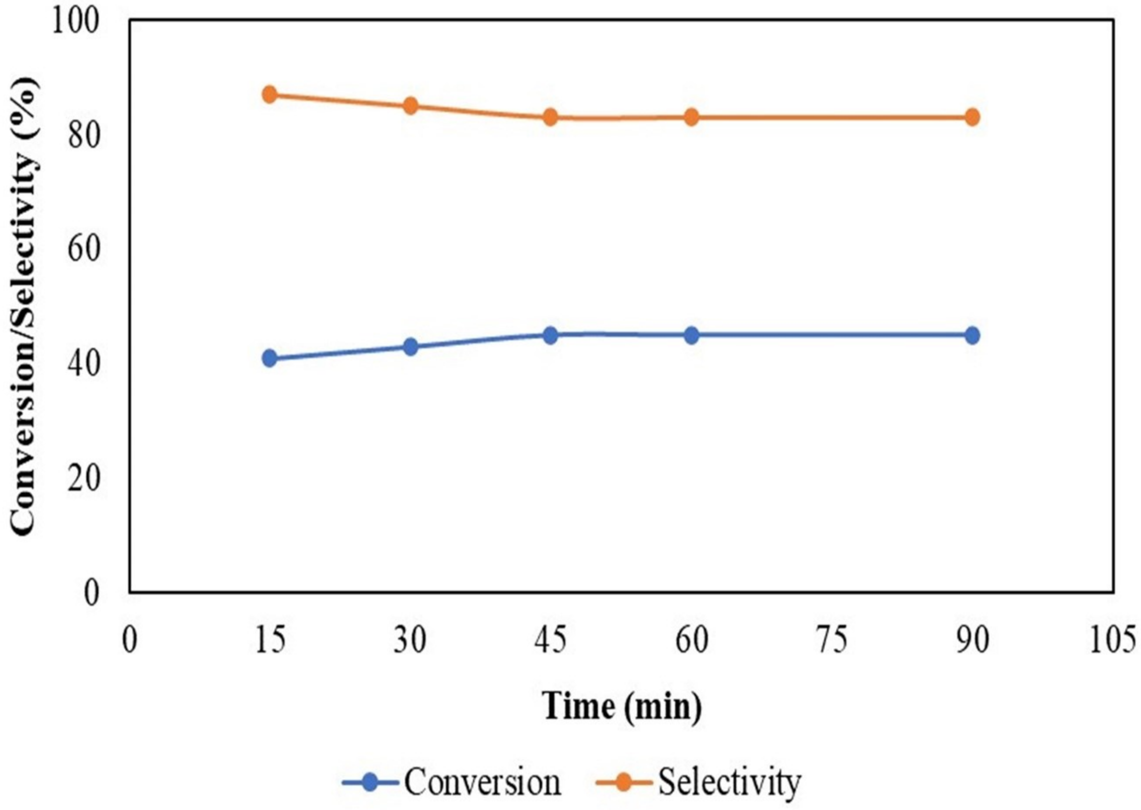


Figure S10. Synthesis of 1-naphthyl glycidyl ether in a batch reactor (normal glass reactor). Epichlorohydrin 0.08 mol, n-decane 0.016 mol, toluene 100 mL, 1-naphthol 0.08 mol, sodium hydroxide 0.16 mol, sodium chloride 0.39 mol and tetra butyl ammonium bromide 0.09 mol, water 100 mL, temperature- 30 °C, speed of agitation for batch reactor 1000 rpm.

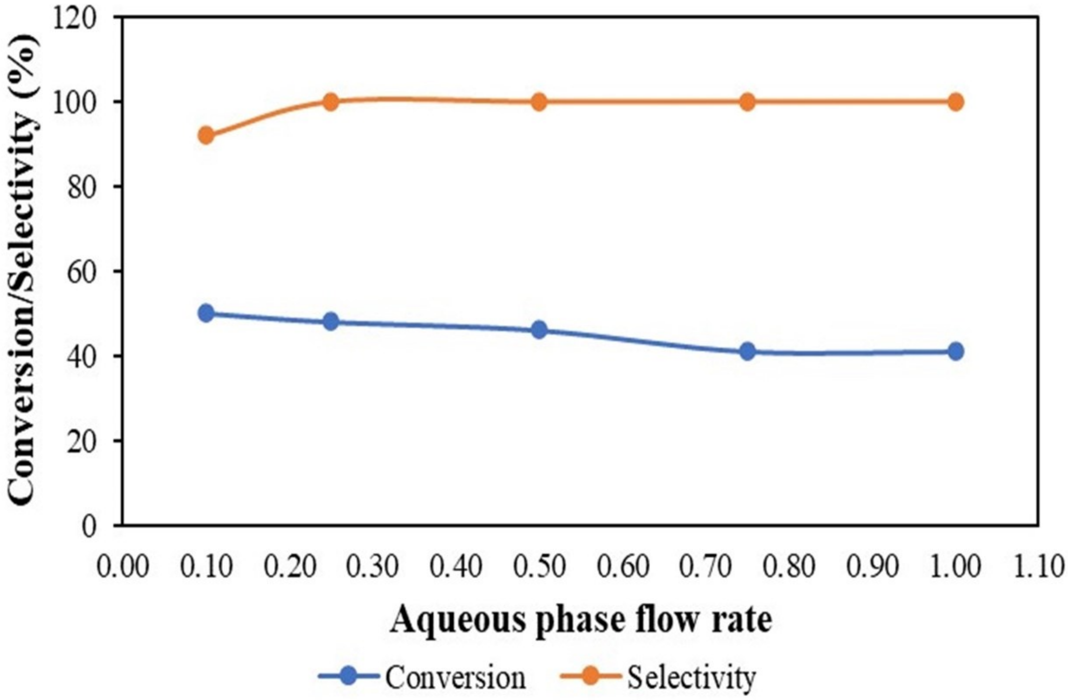


Figure S11. Effect of aqueous phase flow rate. 1-Naphthol 0.08 mol, sodium hydroxide 0.16 mol, epichlorohydrin 0.08 mol, tetra butyl ammonium bromide 0.09 mol, n-decane 0.016 mol, sodium chloride 0.39 mol, toluene 100 mL, water 100 mL, catalyst phase flow rate- 1.25 mL/min, organic phase flow rate- 0.5 mL/min, temperature- 30 °C.

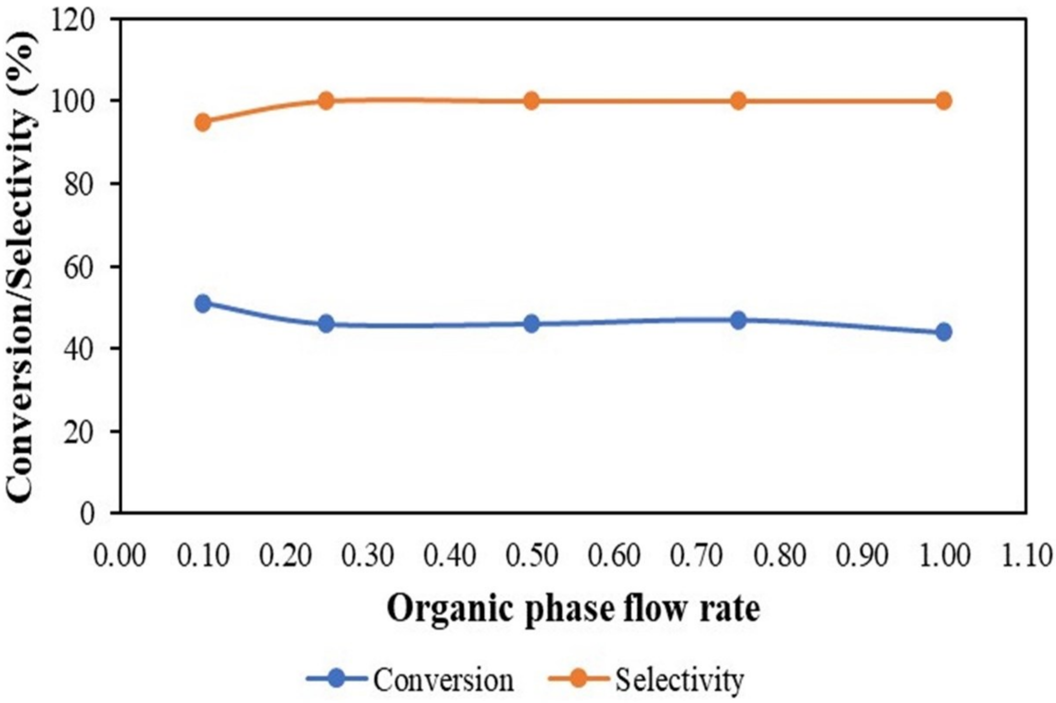


Figure S12. Effect of organic phase flow rate. 1-Naphthol 0.08 mol, sodium hydroxide 0.16 mol, epichlorohydrin 0.08 mol, tetra butyl ammonium bromide 0.09 mol, n-decane 0.016 mol, sodium chloride 0.39 mol, toluene 100 mL, water 100 mL, aqueous phase flow rate- 0.5 mL/min, catalyst phase flow rate- 1.25 mL/min, temperature- 30 °C.

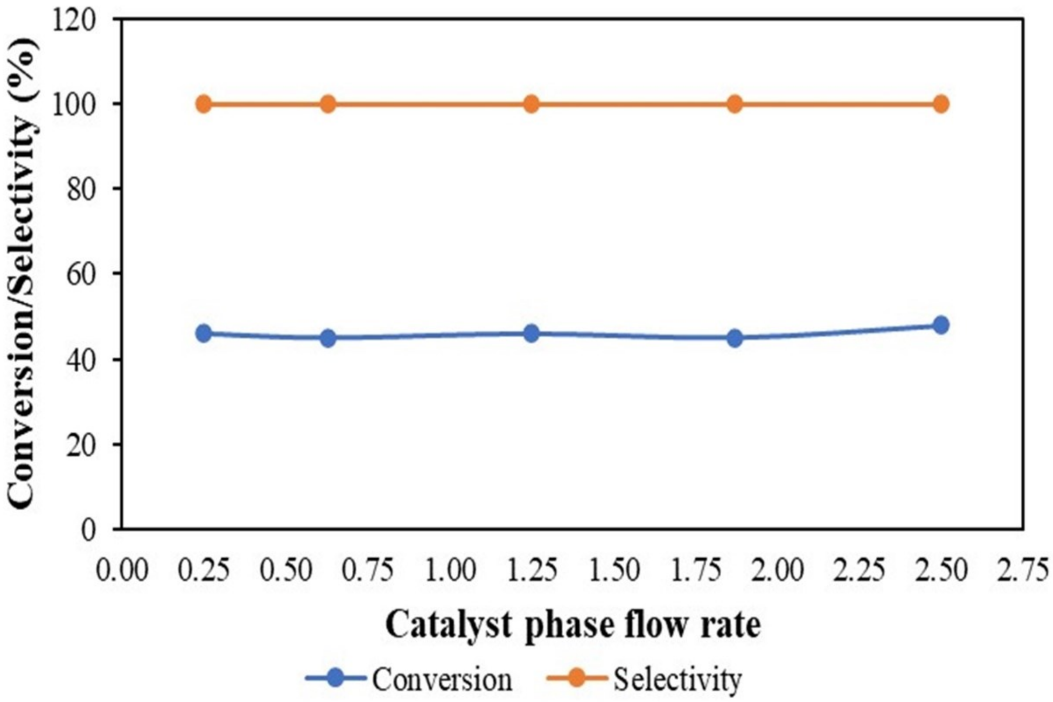


Figure S13. Effect of catalyst phase flow rate. 1-Naphthol 0.08 mol, sodium hydroxide 0.16 mol, epichlorohydrin 0.08 mol, tetra butyl ammonium bromide 0.09 mol, n-decane 0.016 mol, sodium chloride 0.39 mol, toluene 100 mL, water 100 mL, aqueous phase flow rate- 0.5 mL/min, organic phase flow rate- 0.5 mL/min, temperature- 30 °C.