# CFD STUDY OF THE NUMBERING UP MEMBRANE MICROREACTORS FOR $CO_2$ CAPTURE

**E. Harkou [1], S. Hafeez [2], G. Manos [3] , A. Constantinou [1,2]***

[1] Department of Chemical Engineering, Cyprus University of Technology, 57 Corner of Athinon and Anexartisias, 3036 Limassol, Cyprus.
[2] Division of Chemical & Energy Engineering, School of Engineering, London South Bank University, London SE1 0AA, UK.
[3] Depertment of Chemical Engineering, University College London, London WCIE 7JE, UK.
* *Email: axilleas.constantinou@gmail.com*

## ABSTRACT

Carbon Dioxide is one of the major atmospheric greenhouse gases (GHG) due to the dependence of fossil fuels. The continuous increase of $CO_2$ concentration and it's long atmospheric lifetime may cause long-term negative effects on the climate. It is important to develop technologies in order to capture and minimize those emissions into the atmosphere. The objective of this work is to design and study theoretically and experimentally microstructured reactors in parallel. Based on the approach of the numbering-up microreactors this work examines the flow uniformity of each plate of the microreactor. The aim of the numbering-up study is to design a microreactor capable to be used at industrial scale, as a capture system, with high throughput comparing to the single microchannel reactor and to obtain even flow distribution at each plate of the reactor.

The designed microreactor was studied for gas (20vol% $CO_2/N_2$) and liquid (2M NaOH) laminar flows. Nearly uniform flow distribution was achieved at each layer of the numbering-up microreactor according to the carried-out 3D CFD models for both gas and liquid flows. Also, experimental results were obtained from studies on $CO_2$ removal, to compare to the single channel microreactor and the CFD models. The CFD simulations showed nearly uniform flow distribution in contrast to the experimental results which showed that uneven flow distribution might obtained due to maldistribution or breakthrough of liquid into the gas phase or vice versa. Lastly, the effect of the radius of the inlet and outlet tubes is examined on flow distribution.

**KEYWORDS:** $CO_2$ Capture, Membrane, Microreactor, Numbering-up, CFD.

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