Proceedings of the 4th World Congress on Momentum, Heat and Mass Transfer (MHMT'19)
Rome, Italy – April, 2019
Paper No. ENFHT 139
DOI: 10.11159/enfht19.139

A New Approach for Removing Bubble in Microfluidic Systems

Hossein Zargartalebi[1,2], Razieh Salahandish[1,2], Amir Sanati Nezhad[1,2]
[1]BioMEMS and Bioinspired Microfluidic Laboratory, Department of Mechanical and Manufacturing Engineering,
University of Calgary
Calgary, Alberta, Canada
[2]Center for BioEngineering Research and Education, University of Calgary
Calgary, Alberta, Canada
hossein.zargartalebi@ucalgary.ca; razieh.salahandish@ucalgary.ca; amir.sanatinezhad@ucalgary.ca

Extended Abstract

The generated bubbles in microfluidic systems has become among the most recurring concerns recently [1]. Due to the micrometric dimensions of the channels, connections, tubes as well as different bubble-generated processing in the enclosed microchips, the gaseous bubble removal can be a huge challenge and be pernicious for the experiment. Since the bubble generation rate is arbitrary, it is hard to have repeatable results in different tests. To overcome this issue, several investigations have been performed employing different types of bubble trappers [1- 3]. However, in some specific cases, when the process is happening in the microfluidic platform, it contributes to generation of bubbles; hence, the high rate of bubble production outweighs the bubble trapper capacity. Therefore, a new approach for this regard is highly demanded. This paper is aimed at designing a microfluidic platform to efficiently eliminate a large number of bubbles in the system. We specifically designed a multi-channel microchip in which all the tiny bubbles in the system are eliminated in a short period of time. This bubble removal approach is based on the pressure difference between two bubbles with various sizes. In this mechanism, a large air bubble is intentionally implemented into the system in order to gather all the tiny bubbles and then, it is withdrawn from the system. Since the pressure in the small bubbles are higher than the large air bubble, they are unstable and all of them coalesce to the large bubble once they contact with each other. The function and flow rate of infusing (Constant flow, 20 μL/Sec) and withdrawing (Pulse flow, 25 μL/Sec) the air bubble as well as the size and pattern of micro-channels have been optimized to achieve the maximum performance in bubble removal approach. The designed system is applied for microfluidic-based functionalization of biosensors in which the electrochemical bubbles are generated during functionalization of nanocomposite on the electrode, which lead to decrease in the sensitivity of the nano-biosensor. The results showed that using this bubble removal system, the performance of the microfluidic-based electrode functionalization was increased up to 50 %.

References

[1] C. Lochovsky, S. Yasotharan, and A. Günther, “Bubbles no more: in-plane trapping and removal of bubbles in microfluidic devices,” *Lab on a Chip*, vol. 12, no. 3, pp. 595-601, 2012.
[2] S. Chung, J. Park, Y. Lee, C. Chung, D. C. Han and J. K. Chang, “Development of micro Hemocytometer for human erythrocyte analysis for the early detection of cancer,” in *Microtechnologies in Medicine & Biology 2nd Annual International IEEE-EMB Special Topic Conference*, 2002, pp. 496-499
[3] P. Duarte-Guevara, C. Duarte-Guevara, A, Ornob and R. Bashir, “On-chip PMA labeling of foodborne pathogenic bacteria for viable qPCR and qLAMP detection,” *Microfluidics and Nanofluidics*, vol. 20, no. 8, pp. 114, 2016.